JP1000269918

PATENT ABSTRACTS OF JAPAN

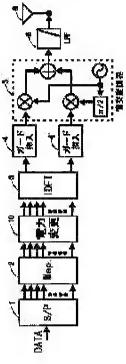
(11)Publication number : 2000-269918
(43)Date of publication of application : 29.09.2000

(51)Int.Cl. H04J 11/00

(21)Application number : 11-069775
(22)Date of filing : 16.03.1999

(71)Applicant : MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor : YOMO HIDEKUNI
YAMAMOTO HIROMICHI
KUNIEDA MASANORI

(54) ORTHOGONAL FREQUENCY DIVISION MULTIPLEX TRANSMISSION SYSTEM AND TRANSMITTER AND RECEIVER USING THE SAME



(57)Abstract:
PROBLEM TO BE SOLVED: To obtain with a simple method an OFDM transmission system effectively utilize frequencies by fully suppressing the spectrum components of a signal out-band.
SOLUTION: A power revision device 10 receives each subcarrier whose signal point is arranged by a mapping device 2, so as to form a shape of frequency spectrums with subcarrier power whose gradient is gradually decreased as the power is separated from a center frequency in the area of a signal band is away from the center frequency by a prescribed frequency width or over, so that frequencies are utilized effectively with a simple method.

CLAIMS

[Claim(s)]
[Claim 1]In a communication method using an orthogonal frequency division multiplex (OFDM) transmission system with which each subcarrier was modulated, in a field distant [more than constant frequency width] from center frequency in a signal band. An orthogonal frequency division multiplex transmission system using signal transmission in which frequency spectrum shape was formed so that it might have the inclination which makes subcarrier electric power small gradually as it separates from said center frequency.
[Claim 2]A sending set using the orthogonal frequency division multiplex transmission system according to claim 1 having an electric power alteration means which makes small gradually subcarrier electric power of a field distant [more than constant frequency width] from center frequency in a signal band as it separates from center frequency.
[Claim 3]While enlarging gradually subcarrier electric power of a field distant [more than constant frequency width] from center frequency in a signal band as it separates from center frequency, A receiving set using the orthogonal frequency division multiplex transmission system according to claim 1 having a zone selection amplifying means with a filtering function which removes a signal of a frequency domain outside said signal band.
[Claim 4]The orthogonal frequency division multiplex transmission system according to claim 1 characterized by what signal transmission was formed for of a subcarrier selected according to importance.
[Claim 5]The orthogonal frequency division multiplex transmission system according to claim 4, wherein a subcarrier judged that importance of signal transmission is low is arranged and formed in a frequency spectrum field distant from center frequency.
[Claim 6]The orthogonal frequency division multiplex transmission system according to claim 4 or 5 with which signal transmission is characterized by including transmission-line-frequency characteristic information.
[Claim 7]The sending set comprising according to claim 2:
An importance examining means which inputs send data and contents information, judges importance of each subcarrier using the orthogonal frequency division multiplex transmission system according to claim 4 or 5, and outputs importance information.
An importance consideration S/P conversion method which inputs said send data and said importance information, chooses a subcarrier based on said importance information, and performs a serial / parallel (S/P) conversion.

[Claim 8]The sending set according to claim 2 which is provided with the following and characterized by an electric power change machine changing subcarrier electric power based on said transmission-line-frequency characteristic information.
An importance examining means which inputs send data and contents information, judges importance of each subcarrier using the orthogonal frequency division multiplex transmission system according to claim 6, and outputs importance information.
An importance consideration S/P conversion method which inputs said send data, said importance information, and transmission-line-frequency characteristic information, and

chooses a subcarrier based on said importance information and said transmission-line-frequency characteristic information, and performs a serial / parallel (S/P) conversion.

[Claim 9]The sending set comprising according to claim 2:
An electric power change machine which is provided with a numerical control oscillator (NCO) which inputs a timing signal and a subcarrier and outputs subcarrier electric power of an in-phase component and a quadrature component according to said subcarrier by a subcarrier number, and changes a power value of subcarrier electric power of said in-phase component and a quadrature component.
The 1st adding machine adding a power value of an in-phase component after change.
The 2nd adding machine adding a power value of a quadrature component after change.
A quadrature modulation machine which inputs an output of said 1st adding machine, and an output of said 2nd adding machine, and performs quadrature modulation.

[Claim 10]The sending set comprising according to claim 9:
A phase step generator by which a numerical control oscillator outputs a phase step value from which change of a phase turns into a loose and continuous change in time.
An accumulator adding said phase step value.

[Claim 11]The sending set according to claim 9 or 10 which is provided with the following and characterized by controlling said coefficient-of-variable-capacitance setting device so that change of amplitude amplifies or declines gently in time.
A coefficient-of-variable-capacitance setting device which generates a coefficient of variable capacitance based on a timing signal.
A multiplier which multiplies an output of a numerical control oscillator by said coefficient of variable capacitance.

[Claim 12]The sending set comprising according to any one of claims 9 to 11:
An address determination means to determine an address value corresponding to a subcarrier in a numerical control oscillator.
A memory measure which is shared with all the numerical control oscillators for a subcarrier number, and chooses and outputs a value based on said address value.

[Claim 13]A sending set given in 11 from claim 9 characterized by comprising the following.
An address determination means to determine an address value corresponding to a subcarrier in a numerical control oscillator.
An address coincidence detection means to be shared with all the numerical control oscillators for a subcarrier number, to judge whether there is nothing that inputted all the address values and was in agreement, and to output a decision value.
An address shifting means which carries out an initial-complement shift, outputs an address value when said decision value includes coincidence information, and outputs an address value as it is when there is no coincidence information.
A memory measure which chooses and outputs a value based on an address value from said address shifting means.

[Claim 14]The sending set comprising according to claim 12 or 13:
ROM where a memory measure saved an output value matched with an input.
A control means which extracts and carries out the parallel output of the value which inputs all the address values and corresponds from said ROM based on each, respectively.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the sending set and receiving set using the orthogonal frequency division multiplex (OFDM) transmission system and it by which each subcarrier was modulated which are used for radio.
[0002]
[Description of the Prior Art]When carrying out wireless transfer of the OFDM signal conventionally, the spectrum outside a signal band needed to be oppressed enough and it was made to oppress with the band-pass filter used in a high frequency circuit etc. so that it may not have an adverse effect on the channel of the adjoining radio frequency. Since it is difficult to make center frequency variable when using a band-pass filter, in order to transmit by desired radio frequency channels, After carrying out upconverting of the band-pass filter output, image frequency needed to be further oppressed with a low pass filter or a high pass filter, and it had the fault that circuit structure was large.
[0003]The feature of an OFDM signal is used, the subcarrier of the end of a signal band is making access speed later than the subcarrier near a center, and how to oppress the spectrum outside a signal band is also known. However, when the method which changes the access speed of this subcarrier generates guard time, it is impossible to use the insertion method of guard time which is performed with the usual OFDM system. Namely, although the method of copying a back portion to the head of a symbol among the symbols after inverse discrete Fourier transform is used, the usual guard time insertion method, In the case of the method which changes the access speed of a subcarrier, about the subcarrier with slow access speed, inverse discrete Fourier transform is carried out independently, additional processing in which it adds to the guard time generated only by the subcarrier with early access speed will be needed, and circuit structure will become large.
[0004]Below, the conventional sending set and a receiving set are explained briefly.
[0005]The structure of conventional OFDM transceiving equipment is shown in drawing 18. In a sending set, after changing into parallel data the serial data which should be transmitted with the S/P converter 1, mapping for line type modulation is given with the mapping machine 2. The inverse discrete Fourier transform machine (IDFT) 3 following the latter part carries out inverse discrete Fourier transform, and the portion behind a symbol is copied to the head of a symbol in the guard aedeagus 4. Then, after quadrature modulation is carried out with the quadrature modulation machine 5, the spectrum outside a signal band is oppressed with the band-pass filter (BPF) 6 with constant center frequency.
[0006]Then, in order to make it in agreement with the frequency of the radio frequency

channels which should transmit, upconverting is carried out by the up converter 7, in order to remove an image, the low pass filter 8 is passed, and it emanates to a radio transmission line from the antenna 9.
[0007]In a receiving set, among the signals received with the antenna 11, the band-pass filter 12 removes ingredients other than a desired zone, and they are inputted into the latter orthogonal demodulators 13. The low pass filter 14 for removing the image produced in orthogonal demodulators is used for the latter part of the orthogonal demodulators 13. Conventionally, since it was an object for image removal, this low pass filter 14 did not have the characteristic made to amplify in a signal band.
[0008]Next, it is changed into the signal of a frequency domain by the discrete Fourier transform device (DFT) 17 after the guard removal machine 16 removes the guard interval inserted at the transmitting side after being changed into the digital signal by A/D converter 15. Next, after getting over with the demapping machine 18 corresponding to mapping of the transmitting side, it has the composition that received data are outputted by the P/S converter 19.
[0009]
[Problem(s) to be Solved by the Invention]When carrying out wireless transfer of the signal of an OFDM transmission system, in a conventional method and device, a circuit complicated as mentioned above will be needed, and circuit structure will become large. However, in order to use the limited frequency effectively, it is desirable to fully oppress the spectral component outside a signal band by a simple method.
[0010]An object of this invention is to realize the sending set and receiving set using the OFDM transmission system and it which can use frequency effectively by fully oppressing the spectral component outside a signal band by a simple method.
[0011]
[Means for Solving the Problem]In order to solve this technical problem, in a field distant [more than constant frequency width] from center frequency in a signal band, this invention. It is considered as an orthogonal frequency division multiplex transmission system using signal transmission in which frequency spectrum shape was formed so that it might have the inclination which makes subcarrier electric power small gradually as it separates from said center frequency.
[0012]A sending set using such an orthogonal frequency division multiplex transmission system is constituted.
[0013]A receiving set using such an orthogonal frequency division multiplex transmission system is constituted.
[0014]A spectrum outside a signal band can be made small by a simple method by this, and it becomes possible to use frequency effectively.
[0015]
[Embodiment of the Invention]In the communication method using the orthogonal frequency division multiplex (OFDM) transmission system with which each subcarrier was modulated as for the invention of this invention according to claim 1, In the field distant [more than constant frequency width] from center frequency in the signal band. As it has the inclination which makes subcarrier electric power small gradually as it separates from said center frequency, it is an orthogonal frequency division multiplex transmission system using the signal transmission in which frequency spectrum shape was formed, and it has the operation that frequency can be effectively used by a simple

method.
[0016]The invention according to claim 2 the subcarrier electric power of the field distant [more than constant frequency width] from center frequency in the signal band, It is a sending set using the orthogonal frequency division multiplex transmission system according to claim 1 having an electric power alteration means gradually made small as it separates from center frequency, and it has the operation that frequency can be effectively used with simple composition.
[0017]While it enlarges gradually subcarrier electric power of the field distant [more than constant frequency width] from center frequency in the signal band as the invention according to claim 3 separates from center frequency, It is a receiving set using the orthogonal frequency division multiplex transmission system according to claim 1 having a zone selection amplifying means with the filtering function which removes the signal of the frequency domain outside said signal band, Without changing C/N (carrier power versus noise ratio) of each subcarrier, dynamic ranges, such as a discrete Fourier transform device following the latter part, can be made to improve, and it has the operation that frequency can be effectively used with simple composition.
[0018]The invention according to claim 4 is the orthogonal frequency division multiplex transmission system according to claim 1 characterized by what signal transmission was formed for of the subcarrier selected according to importance, It has the operation that flexible transmission systems can be built with constituting a spectrum by the subcarrier according to importance.
[0019]If signal transmission considers it as the orthogonal frequency division multiplex transmission system according to claim 4, wherein the subcarrier judged that importance is low is arranged and formed in the frequency spectrum field distant from center frequency like the invention according to claim 5 especially, Transmitting the signal with high importance near the center of the large signal band of subcarrier electric power, the signal with low importance has the operation that the transmission quality according to the importance of the signal is securable by transmitting at the end of the small signal band of subcarrier electric power.
[0020]Signal transmission is the orthogonal frequency division multiplex transmission system according to claim 4 or 5, wherein transmission-line-frequency characteristic information is included, and the invention according to claim 6 follows change of a transmission line, and has the operation that transmission systems with high reliance reliability can be built.
[0021]The importance examining means which the invention according to claim 7 inputs send data and contents information, judges the importance of each subcarrier using the orthogonal frequency division multiplex transmission system according to claim 4 or 5, and outputs importance information, It is the sending set according to claim 2 having an importance consideration S/P conversion method which inputs said send data and said importance information, chooses a subcarrier based on said importance information, and performs a serial / parallel (S/P) conversion, It has the operation that the sending set for building flexible transmission systems can be formed with constituting a spectrum by the subcarrier according to importance.
[0022]The importance examining means which the invention according to claim 8 inputs send data and contents information, judges the importance of each subcarrier using the orthogonal frequency division multiplex transmission system according to claim 6, and

outputs importance information, It has an importance consideration S/P conversion method which inputs said send data, said importance information, and transmission-line-frequency characteristic information, and chooses a subcarrier based on said importance information and said transmission-line-frequency characteristic information, and performs a serial / parallel (S/P) conversion, Also in [an electric power change machine is the sending set according to claim 2 changing subcarrier electric power based on said transmission-line-frequency characteristic information, and] transmission line states, such as frequency selective fading, It has the operation that a reliable sending set can be formed rather than being able to follow frequency characteristic change of a transmission line.

[0023]The invention according to claim 9 is provided with the numerical control oscillator (NCO) which inputs a timing signal and a subcarrier and outputs the subcarrier electric power of an in-phase component and a quadrature component according to said subcarrier by a subcarrier number, The electric power change machine which changes the power value of the subcarrier electric power of said in-phase component and a quadrature component, The 1st adding machine adding the power value of the in-phase component after change, and the 2nd adding machine adding the power value of the quadrature component after change, It is the sending set according to claim 2 having a quadrature modulation machine which inputs the output of said 1st adding machine, and the output of said 2nd adding machine, and performs quadrature modulation, and it has the operation that the spectrum outside a signal band can be oppressed, satisfying the rectangular conditions between subcarriers correctly.

[0024]The invention according to claim 10 a numerical control oscillator, The phase step generator which outputs a phase step value from which change of a phase turns into a loose and continuous change in time, It is the sending set according to claim 9 having an accumulator adding said phase step value, and has the operation that the spectrum outside a signal band can be oppressed with simple composition.

[0025]The coefficient-of-variable-capacitance setting device in which the invention according to claim 11 generates a coefficient of variable capacitance based on a timing signal, It is the sending set according to claim 9 or 10 controlling said coefficient-of-variable-capacitance setting device so that it has a multiplier which multiplies the output of a numerical control oscillator by said coefficient of variable capacitance and change of amplitude amplifies or declines gently in time, It has the operation that the spectrum outside a signal band can be oppressed with simple composition.

[0026]The invention according to claim 12 a numerical control oscillator, An address determination means to determine the address value corresponding to a subcarrier, It is the sending set according to any one of claims 9 to 11 having a memory measure which is shared with all the numerical control oscillators for a subcarrier number, and chooses and outputs a value based on said address value, By sharing the big memory measure of circuit structure, for example as shown in a look-up table, it has the operation that the miniaturization of a sending set can be attained.

[0027]The invention according to claim 13 a numerical control oscillator, An address determination means to determine the address value corresponding to a subcarrier, An address coincidence detection means to be shared with all the numerical control oscillators for a subcarrier number, to judge whether there is nothing that inputted all the address values and was in agreement, and to output a decision value, The address shifting

means which carries out an initial-complement shift, outputs an address value when said decision value includes coincidence information, and outputs an address value as it is when there is no coincidence information, It is a sending set given in 11 from claim 9 having a memory measure which chooses and outputs a value based on the address value from said address shifting means, For example, it is sharing, while a memory measure as shown in a look-up table can be used efficiently, it has the operation that peak powers are reducible.

[0028]ROM where the invention according to claim 14 saved the output value by which the memory measure was matched with the input, It is the sending set according to claim 12 or 13 having a control means which extracts and carries out the parallel output of the value which inputs all the address values and corresponds from said ROM based on each, respectively, For example, it is sharing, ROM as shown in a look-up table can be used efficiently, and it has the operation that an easy circuit design becomes possible.

[0029]Hereafter, an embodiment of the invention is described using drawing 17 from drawing 1.

[0030](Embodiment 1) Drawing 1 is a block diagram showing the composition of the sending set by this embodiment. In drawing 1, as for a guard aedeagus and 5, a mapping machine and 3 are [LPF and 9] transmission antennas a quadrature modulation machine and 8 an IDFT machine and 4 a S/P converter and 2, and, as for 1, these perform the same operation as that for which the same numerals were attached with the sending set shown in drawing 18 explained by the Prior art.

[0031]The sending set of drawing 1 arranges the electric power change machine 10 which is a means which makes subcarrier electric power in the direction of an end smaller than near the center of a signal band in the latter part of the mapping machine 2 in the conventional sending set of drawing 18.

[0032]Operation of the sending set of drawing 1 inputs the digital data inputted into the S/P converter 1, carries out serial/parallel conversion, performs signal point arrangement for abnormal conditions with the mapping machine 2, and makes subcarrier electric power in the direction of an end smaller than near the center of a signal band with the electric power change machine 10. And carry out inverse Fourier transform of the parallel signal with the IDFT machine 3, output a complex signal, and by the guard aedeagus 4. After copying a back portion to the head of a symbol among the complex signal symbols after inverse discrete Fourier transform, carry out quadrature modulation of the complex signal with which the guard interval was inserted with the quadrature modulation machine 5, and the image produced by quadrature modulation in LPF8 is removed, Electromagnetic waves are emitted to a radio transmission line as a sending signal from the transmission antenna 9.

[0033]Explanation of concrete operation of the electric power change machine 2 is shown below. The schematic diagram in which drawing 2 shows the frequency spectrum of the input signal to the electric power change machine 2, and drawing 3 are the schematic diagrams showing the frequency spectrum of the output signal from an electric power change machine. Here, N shows a subcarrier number and fs shows the subcarrier frequency interval.

[0034]Although the input signal has a spectrum of a uniform level in the signal band like drawing 2, it outputs the signal which made small electric power of the signal of the end part of a signal band which affects frequency spectrum out of band greatly like drawing 3

at the time of an output.
[0035]As an example of the concrete composition of the electric power change machine 2, it has the correlation table of an output to an input, and the power can be converted by making it operate so that the signal according to the level of the input signal may be chosen and outputted, for example.
[0036]Since the level of frequency spectrum out of band can be pressed down by having a means to change such electric power, frequency effective use is realizable in simple.
[0037]An electric power change machine in the parallel signal which the signal by which quadrature modulation was carried out inputs into the inverse discrete Fourier transform machine beforehand as the subcarrier electric power in the direction of an end is small rather than near the center of a zone, Since it is a means to change the electric power of what influences the electric power of the signal after quadrature modulation, it is also possible to give this function to the mapping machine 2 of the preceding paragraph.
[0038](Embodiment 2) Drawing 4 is a block diagram showing the composition of the receiving set by this embodiment, and receives the signal transmitted with the sending set of (Embodiment 1). In drawing 4, 11 a receiving antenna and 12 a band-pass filter and 13 Orthogonal demodulators, As for a guard removal machine and 17, 15 is [a demapping machine and 19] P/S converters the discrete Fourier transform (DFT) machine and 18 an A/D converter and 16, and these perform the same operation as that for which the same numerals were attached with the receiving set shown in drawing 18 explained by the Prior art.
[0039]In the latter part of the orthogonal demodulators 13 in the conventional receiving set of drawing 18, the receiving set of drawing 4 arranges the zone selection amplifier 100 which is a means which makes subcarrier electric power in the direction of an end larger than near the center of a signal band at the same time it gives the characteristic of a low pass filter to image removal.
[0040]Operation of the receiving set of drawing 4 receives the electromagnetic waves on a radio transmission line with the receiving antenna 11, Carry out orthogonal demodulation of the high frequency signal by the orthogonal demodulators 13, the band-pass filter 12 removes a desired ingredient out of band, change into a low-pass signal, and with the zone selection amplifier 100. Are in the direction of the end of a signal band and the frequency component of the subcarrier transmitted with small electric power is amplified at the same time it removes an image component, Being near the center of a signal band, the frequency component of the subcarrier transmitted with large electric power passes the filter which has a frequency characteristic which is not made to amplify.
[0041]And an analog signal is changed into a digital signal with A/D converter 15, The guard interval inserted in the transmitting side with the guard removal machine 16 is removed, It changes into received data by the DFT machine's 17 performing discrete Fourier transform from an in-phase signal and a rectangular signal, and the demapping machine's 18 performing demapping corresponding to mapping of the transmitting side, and changing a parallel signal into a serial signal with the P/S converter 19.
[0042]Explanation of concrete operation of the zone selection amplifier 100 is shown below. The schematic diagram showing the characteristic of the low pass filter for image removal of the former [drawing 5] and drawing 6 are the schematic diagrams showing the characteristic of the zone selection amplifier 100 used by this embodiment. Here, N shows a subcarrier number and fs shows the subcarrier frequency interval.

[0043]Since the signal transmitted from the conventional sending set has spectral shape like drawing 2, in the low pass filter of the conventional receiving set, as shown in drawing 5, the electric power outside a signal band is only prevented, and a portion out of band has spectral characteristics with a certain amount of inclination like drawing 5 actually. However, since the signal which has frequency spectrum shape like drawing 3 at the transmitting side is transmitted in this embodiment, Like drawing 6, are in the direction of the end of a signal band and the frequency component of the subcarrier transmitted with small electric power is amplified, It is passing the signal which it is near the center of a signal band, and the frequency component of the subcarrier transmitted with large electric power arranges the zone selection amplifier 100 with the filter which has a frequency characteristic which is not amplified, and has a spectrum like drawing 3, The signal of a uniform level can be acquired within a zone.
[0044]It becomes possible to decrease the operation error produced by fixed-point arithmetic, without being able to improve the dynamic range of A/D converter 15 arranged in the latter part by providing a means to have such a function, or the discrete Fourier transform device 17, and changing C/N of each subcarrier.
[0045](Embodiment 3) Drawing 7 is a block diagram showing a part of input stage of the sending set by this embodiment. In drawing 7, the importance investigation machine with which 20 investigates the importance of input data, and 21 are importance consideration S/P converters which operate based on the result of the importance investigation machine 20, and it is inserted in the preceding paragraph of the mapping machine 2. The composition after the mapping machine 2 is the same as that of drawing 1.
[0046]Operation of the input stage of the sending set shown in drawing 7 inputs input data and contents into the importance investigation machine 20, investigates importance, and is the importance consideration S/P converter 21, The signal band of the subcarrier transmitted according to the level of importance is chosen, the signal with high importance is transmitted near the center of the large signal band of subcarrier electric power, and the signal with low importance forms the frequency spectrum of a sending signal so that it may transmit at the end of the small signal band of subcarrier electric power.
[0047]Drawing 8 is a schematic diagram showing the relation of the frequency spectrum and signal importance by S/P conversion with the importance consideration S/P converter 21. Thus, the frequency spectrum of a sending signal is formed so that the signal with high importance may be transmitted near the center of the large signal band of subcarrier electric power and the signal with low importance may be transmitted at the end of the small signal band of subcarrier electric power.
[0048]In a receiver, it becomes possible to output the usual received-data series by performing P/S conversion corresponding to the importance consideration S/P conversion defined at the transmitting side. This importance consideration S/P conversion method can define the information on importance by the transmitting side and a receiver beforehand, or can transmit the information on a S/P converting method from the transmitting side to a receiver, and can also change the information on the importance of an importance consideration S/P conversion method if needed.
[0049]When performing FEC (Forward Error Correct) for correcting a transmission error here, it is also possible to perform FEC independently at given importance, and it is also possible to perform FEC in consideration of the signal series after importance

consideration S/P conversion.
[0050](Embodiment 4) Drawing 9 is a block diagram showing the composition of the transmitter by this embodiment. In drawing 9, as for 101, a receiving set and 103 are sending sets a transmitter and 102, and other numerals are the same as that of what was used by drawing 8 from drawing 1. In this embodiment, transmit the frequency characteristic of the transmission line acquired by DFT17 of the receiving set 102 to the transmitting side, and on a basis this transmission-line-frequency characteristic in a sending set. The electric power of each subcarrier is changed in the electric power change machine 10, and it constitutes so that the subcarrier which transmits according to the importance of a signal can be chosen, and the S/P conversion method of the importance consideration S/P converter 21 can be changed.
[0051]By having such composition, by frequency selective fading etc., among the received signals, for example when the electric power of a certain subcarrier is small, In the electric power change machine 10, enlarge electric power of the subcarrier, and. The signal with high importance can form the signal according to the importance of the signal while it can be changed with the importance consideration S/P converter 21 and can make a subcarrier a suitable size so that it may transmit by another subcarrier.
[0052]By this embodiment, the more reliable transmission systems which can follow change of a transmission line can be built by forming the sending set and receiving set of the above composition.
[0053](Embodiment 5) Drawing 10 is a block diagram showing the composition of the sending set by this embodiment. In drawing 10, a sending set, The electric power change machine 10 which changes the output power of the numerical control oscillators 22 (NCO:Numerically Controlled Oscillator) for a subcarrier number, these inphases, and a quadrature component, and the in-phase component of this output. It has adding machine 23' adding a part for the adding machine 23 and an orthogonality to add, and the symbol timing generator 24. About other numerals, it is the same as that of what was used by drawing 9 from drawing 1.
[0054]Drawing 11 is a block diagram showing the composition of the numerical control oscillator 22 of the sending set of drawing 10. The numerical control oscillator 22 sets up an initial phase by the initial phase setting device 28 based on the output signal of the mapping machine 2 for every symbol timing from the symbol timing generator 24. The fixed phase value deltaphi25 based on the frequency of each subcarrier is delayed with the delay device 27, and the accumulator 26 accumulates it.
[0055]And in the omission machine 29, accumulated is omitted according to the address length of ROM30 following the latter part after the initial phase set up by the initial phase setting device 28, and a means to add an accumulator value. The value of ROM which makes an address this omitted accumulated is read as amplitude value. Here, the inphase and the quadrature component are memorized by ROM and both ingredients are outputted. When there is change of amplitude like a quadrature amplitude modulation (QAM) method, with the amplitude change machine 31 in the latter part of ROM30, amplitude is changed and it corresponds.
[0056]If the initial phase 28 based on the output signal of the mapping machine 2 is set up for every symbol timing here, since a steep change of a phase arises, the spectrum outside a signal band will become large. Then, it does not change into an instant to the initial phase based on the output of the mapping machine 2, but is made to change to it

gradually in the initial phase setting device 28. Change of amplitude is similarly changed gradually with the amplitude change machine 31. These initial phase setting device 28 and the amplitude change machine 31 operate with the signal from the symbol timing generator 24 synchronizing with symbol timing.
[0057]Thus, when change of a phase or amplitude becomes loose, spectrum out of band can be made small. Since the numerical control oscillator is used, the rectangular conditions between subcarriers are also easily and correctly satisfying.
[0058](Embodiment 6) Drawing 12 is a block diagram showing the composition of the numerical control oscillator of the sending set by this embodiment. In drawing 12, the numerical control oscillator 33 is constituted using the phase step machine 32, the accumulator 26, the delay device 27, the omission machine 29, ROM30, and the amplitude change machine 31, and inputs the signal from the mapping machine 2 and the symbol timing generator 24.
[0059]The phase step machine 32 of numerical control oscillator 33 inside changes phase step deltaphi (t) gradually in order to ease the steep change of an initial phase based on the mapping machine 2 according to the timing from the symbol timing generator 24.
[0060]That is, in order to ease the steep phase change for every symbol timing, the value of the accumulator 26 is changed gradually. Therefore, it is made to change to change of the initial phase instead of constant value gradually with phase step deltaphi (t) in the phase step machine 32. This change is performed based on the signal from the symbol timing generator 24.
[0061]Thus, a steep phase change can be eased by changing the value of the accumulator 26, and it becomes possible to make spectrum out of band small.
[0062](Embodiment 7) Drawing 13 is a block diagram showing some sending sets of the numerical control oscillator circumference by this embodiment. It is characterized by having the coefficient-of-variable-capacitance setting device 35, and the effect of this invention is presented with being constituted with the symbol timing generator 24, the numerical control oscillator (NCO) 22, the mapping machine 2, and the multiplier 34.
[0063]The coefficient-of-variable-capacitance setting device 35 is controlled to make the value of the coefficient of variable capacitance by which the complex signal from NCO22 is multiplied increase gradually as a means to provide the lamp section usually used, in order to ease the phase discontinuity between symbols (or reduction).
[0064]The timing to which the value of a coefficient of variable capacitance is changed gradually is synchronized with the signal from the symbol timing generator 24. And a means to make the value of a coefficient of variable capacitance increase gradually at the head of the symbol section, and to decrease the value of a coefficient of variable capacitance gradually in the end of the symbol section is used.
[0065]With such simple composition, it becomes possible to make spectrum out of band small.
[0066](Embodiment 8) Drawing 14 is a block diagram showing the outline composition of the numerical control oscillator of the sending set by this embodiment. In drawing 14, an amplitude change machine and 35 (35, 35, --) are an address determination part and share ROM whose 36 is a memory measure, and 31 (31, 31, --) corresponds to the numerical control oscillator of drawing 11 or drawing 12.
[0067]Drawing 15 is a block diagram showing an example of the concrete composition of the address determination part 35 in drawing 14, respectively, and each numerals are the

same as that of what was used by drawing 11 or drawing 12.
[0068]Share ROM36 outputs the value corresponding to the address determined by the address determination part 35. The time sharing of the timing which inputs an address into share ROM36 is carried out, and it is kept from colliding between each NCO.
[0069]Since big ROM of circuit structure is sharable by having such composition between each NCO, reduction of circuit structure can be aimed at.
[0070](Embodiment 9) Drawing 16 is a block diagram showing the outline composition of the numerical control oscillator of the sending set by this embodiment. In drawing 16, the memory measure for which an amplitude change machine and 35 (35, 35, --) have an address determination part, 37 has an input bus, and 38 has share ROM and a control device, and 39 are output buses, and 31 (31, 31, --) corresponds to the numerical control oscillator of drawing 11 or drawing 12.
[0071]The memory measure 38 outputs the value corresponding to the address value from the input bus 37 to the output bus 39. Specifically to the input bus 37, they are each address determination parts 35, 35, and 35. -- The address value by which time sharing was carried out in between is inputted, A control device inputs a signal bunch from the input bus 37, a correspondence value is extracted from share ROM, it has composition which carries out parallel processing and is outputted to the output bus 39, and the address is kept from colliding.
[0072]Share ROM which is the look-up table currently shared between having such composition can be used efficiently, and an easy circuit design becomes possible.
[0073](Embodiment 10) Drawing 17 is a block diagram showing the outline composition of the numerical control oscillator of the sending set by this embodiment. In drawing 17, 31 (31, 31, --), as for an amplitude change machine and 35 (35, 35, --), share ROM and 40 are address shift machines, and an address coincidence detector and 41 correspond to the numerical control oscillator of drawing 11 or drawing 12 an address determination part and 36.
[0074]According to this embodiment, each address value determined by the address determination part 35 is compared in the address coincidence detector 41, and when in agreement, in the address shift machine 41, only constant value shifts an address value for congruous addresses in accordance with a certain random rule.
[0075]Thus, by adjusting an address, share ROM36 can be used efficiently. Since the same address value is not simultaneously inputted into share ROM36 by the address coincidence detector 40 and the address shift machine 41, ROM becomes possible [outputting the value corresponding to the inputted address value simultaneously] with them.
[0076]Although drawing 17 shows the case where share ROM36 is used, it is possible to carry out similarly, even when using the memory measure shown by (Embodiment 9).
[0077]
[Effect of the Invention]As mentioned above, according to this invention, in the sending set and receiving set by an OFDM transmission system, it becomes possible to make the spectrum outside a signal band small by a simple method, and the advantageous effect that it can use effectively [frequency] is acquired.

TECHNICAL FIELD

[Field of the Invention]This invention relates to the sending set and receiving set using the orthogonal frequency division multiplex (OFDM) transmission system and it by which each subcarrier was modulated which are used for radio.

PRIOR ART

[Description of the Prior Art]When carrying out wireless transfer of the OFDM signal conventionally, the spectrum outside a signal band needed to be oppressed enough and it was made to oppress with the band-pass filter used in a high frequency circuit etc. so that it may not have an adverse effect on the channel of the adjoining radio frequency. Since it is difficult to make center frequency variable when using a band-pass filter, in order to transmit by desired radio frequency channels, After carrying out upconverting of the band-pass filter output, image frequency needed to be further oppressed with a low pass filter or a high pass filter, and it had the fault that circuit structure was large.

[0003]The feature of an OFDM signal is used, the subcarrier of the end of a signal band is making access speed later than the subcarrier near a center, and how to oppress the spectrum outside a signal band is also known. However, when the method which changes the access speed of this subcarrier generates guard time, it is impossible to use the insertion method of guard time which is performed with the usual OFDM system. Namely, although the method of copying a back portion to the head of a symbol among the symbols after inverse discrete Fourier transform is used, the usual guard time insertion method, In the case of the method which changes the access speed of a subcarrier, about the subcarrier with slow access speed, inverse discrete Fourier transform is carried out independently, additional processing in which it adds to the guard time generated only by the subcarrier with early access speed will be needed, and circuit structure will become large.

[0004]Below, the conventional sending set and a receiving set are explained briefly.

[0005]The structure of conventional OFDM transceiving equipment is shown in drawing 18. In a sending set, after changing into parallel data the serial data which should be transmitted with the S/P converter 1, mapping for line type modulation is given with the mapping machine 2. The inverse discrete Fourier transform machine (IDFT) 3 following the latter part carries out inverse discrete Fourier transform, and the portion behind a symbol is copied to the head of a symbol in the guard aedeagus 4. Then, after quadrature modulation is carried out with the quadrature modulation machine 5, the spectrum outside a signal band is oppressed with the band-pass filter (BPF) 6 with constant center frequency.

[0006]Then, in order to make it in agreement with the frequency of the radio frequency channels which should transmit, upconverting is carried out by the up converter 7, in order to remove an image, the low pass filter 8 is passed, and it emanates to a radio transmission line from the antenna 9.

[0007]In a receiving set, among the signals received with the antenna 11, the band-pass filter 12 removes ingredients other than a desired zone, and they are inputted into the

latter orthogonal demodulators 13. The low pass filter 14 for removing the image produced in orthogonal demodulators is used for the latter part of the orthogonal demodulators 13. Conventionally, since it was an object for image removal, this low pass filter 14 did not have the characteristic made to amplify in a signal band.
[0008]Next, it is changed into the signal of a frequency domain by the discrete Fourier transform device (DFT) 17 after the guard removal machine 16 removes the guard interval inserted at the transmitting side after being changed into the digital signal by A/D converter 15. Next, after getting over with the demapping machine 18 corresponding to mapping of the transmitting side, it has the composition that received data are outputted by the P/S converter 19.

EFFECT OF THE INVENTION

[Effect of the Invention]As mentioned above, according to this invention, in the sending set and receiving set by an OFDM transmission system, it becomes possible to make the spectrum outside a signal band small by a simple method, and the advantageous effect that it can use effectively [frequency] is acquired.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]When carrying out wireless transfer of the signal of an OFDM transmission system, in a conventional method and device, a circuit complicated as mentioned above will be needed, and circuit structure will become large. However, in order to use the limited frequency effectively, it is desirable to fully oppress the spectral component outside a signal band by a simple method.
[0010]An object of this invention is to realize the sending set and receiving set using the OFDM transmission system and it which can use frequency effectively by fully oppressing the spectral component outside a signal band by a simple method.

MEANS

[Means for Solving the Problem]In order to solve this technical problem, in a field distant [more than constant frequency width] from center frequency in a signal band, this invention. It is considered as an orthogonal frequency division multiplex transmission system using signal transmission in which frequency spectrum shape was formed so that it might have the inclination which makes subcarrier electric power small gradually as it separates from said center frequency.
[0012]A sending set using such an orthogonal frequency division multiplex transmission system is constituted.
[0013]A receiving set using such an orthogonal frequency division multiplex transmission system is constituted.
[0014]A spectrum outside a signal band can be made small by a simple method by this, and it becomes possible to use frequency effectively.

[0015]
[Embodiment of the Invention]In the communication method using the orthogonal frequency division multiplex (OFDM) transmission system with which each subcarrier was modulated as for the invention of this invention according to claim 1, In the field distant [more than constant frequency width] from center frequency in the signal band. As it has the inclination which makes subcarrier electric power small gradually as it separates from said center frequency, it is an orthogonal frequency division multiplex transmission system using the signal transmission in which frequency spectrum shape was formed, and it has the operation that frequency can be effectively used by a simple method.
[0016]The invention according to claim 2 the subcarrier electric power of the field distant [more than constant frequency width] from center frequency in the signal band, It is a sending set using the orthogonal frequency division multiplex transmission system according to claim 1 having an electric power alteration means gradually made small as it separates from center frequency, and it has the operation that frequency can be effectively used with simple composition.
[0017]While it enlarges gradually subcarrier electric power of the field distant [more than constant frequency width] from center frequency in the signal band as the invention according to claim 3 separates from center frequency, It is a receiving set using the orthogonal frequency division multiplex transmission system according to claim 1 having a zone selection amplifying means with the filtering function which removes the signal of the frequency domain outside said signal band, Without changing C/N (carrier power versus noise ratio) of each subcarrier, dynamic ranges, such as a discrete Fourier transform device following the latter part, can be made to improve, and it has the operation that frequency can be effectively used with simple composition.
[0018]The invention according to claim 4 is the orthogonal frequency division multiplex transmission system according to claim 1 characterized by what signal transmission was formed for of the subcarrier selected according to importance, It has the operation that flexible transmission systems can be built with constituting a spectrum by the subcarrier according to importance.
[0019]If signal transmission considers it as the orthogonal frequency division multiplex transmission system according to claim 4, wherein the subcarrier judged that importance is low is arranged and formed in the frequency spectrum field distant from center frequency like the invention according to claim 5 especially, Transmitting the signal with high importance near the center of the large signal band of subcarrier electric power, the signal with low importance has the operation that the transmission quality according to the importance of the signal is securable by transmitting at the end of the small signal band of subcarrier electric power.
[0020]Signal transmission is the orthogonal frequency division multiplex transmission system according to claim 4 or 5, wherein transmission-line-frequency characteristic information is included, and the invention according to claim 6 follows change of a transmission line, and has the operation that transmission systems with high reliance reliability can be built.
[0021]The importance examining means which the invention according to claim 7 inputs send data and contents information, judges the importance of each subcarrier using the orthogonal frequency division multiplex transmission system according to claim 4 or 5,

and outputs importance information, It is the sending set according to claim 2 having an importance consideration S/P conversion method which inputs said send data and said importance information, chooses a subcarrier based on said importance information, and performs a serial / parallel (S/P) conversion, It has the operation that the sending set for building flexible transmission systems can be formed with constituting a spectrum by the subcarrier according to importance.

[0022]The importance examining means which the invention according to claim 8 inputs send data and contents information, judges the importance of each subcarrier using the orthogonal frequency division multiplex transmission system according to claim 6, and outputs importance information, It has an importance consideration S/P conversion method which inputs said send data, said importance information, and transmission-line-frequency characteristic information, and chooses a subcarrier based on said importance information and said transmission-line-frequency characteristic information, and performs a serial / parallel (S/P) conversion, Also in [an electric power change machine is the sending set according to claim 2 changing subcarrier electric power based on said transmission-line-frequency characteristic information, and] transmission line states, such as frequency selective fading, It has the operation that a reliable sending set can be formed rather than being able to follow frequency characteristic change of a transmission line.

[0023]The invention according to claim 9 is provided with the numerical control oscillator (NCO) which inputs a timing signal and a subcarrier and outputs the subcarrier electric power of an in-phase component and a quadrature component according to said subcarrier by a subcarrier number, The electric power change machine which changes the power value of the subcarrier electric power of said in-phase component and a quadrature component, The 1st adding machine adding the power value of the in-phase component after change, and the 2nd adding machine adding the power value of the quadrature component after change, It is the sending set according to claim 2 having a quadrature modulation machine which inputs the output of said 1st adding machine, and the output of said 2nd adding machine, and performs quadrature modulation, and it has the operation that the spectrum outside a signal band can be oppressed, satisfying the rectangular conditions between subcarriers correctly.

[0024]The invention according to claim 10 a numerical control oscillator, The phase step generator which outputs a phase step value from which change of a phase turns into a loose and continuous change in time, It is the sending set according to claim 9 having an accumulator adding said phase step value, and has the operation that the spectrum outside a signal band can be oppressed with simple composition.

[0025]The coefficient-of-variable-capacitance setting device in which the invention according to claim 11 generates a coefficient of variable capacitance based on a timing signal, It is the sending set according to claim 9 or 10 controlling said coefficient-of-variable-capacitance setting device so that it has a multiplier which multiplies the output of a numerical control oscillator by said coefficient of variable capacitance and change of amplitude amplifies or declines gently in time, It has the operation that the spectrum outside a signal band can be oppressed with simple composition.

[0026]The invention according to claim 12 a numerical control oscillator, An address determination means to determine the address value corresponding to a subcarrier, It is the sending set according to any one of claims 9 to 11 having a memory measure which is

shared with all the numerical control oscillators for a subcarrier number, and chooses and outputs a value based on said address value, By sharing the big memory measure of circuit structure, for example as shown in a look-up table, it has the operation that the miniaturization of a sending set can be attained.

[0027]The invention according to claim 13 a numerical control oscillator, An address determination means to determine the address value corresponding to a subcarrier, An address coincidence detection means to be shared with all the numerical control oscillators for a subcarrier number, to judge whether there is nothing that inputted all the address values and was in agreement, and to output a decision value, The address shifting means which carries out an initial-complement shift, outputs an address value when said decision value includes coincidence information, and outputs an address value as it is when there is no coincidence information, It is a sending set given in 11 from claim 9 having a memory measure which chooses and outputs a value based on the address value from said address shifting means, For example, it is sharing, while a memory measure as shown in a look-up table can be used efficiently, it has the operation that peak powers are reducible.

[0028]ROM where the invention according to claim 14 saved the output value by which the memory measure was matched with the input, It is the sending set according to claim 12 or 13 having a control means which extracts and carries out the parallel output of the value which inputs all the address values and corresponds from said ROM based on each, respectively, For example, it is sharing, ROM as shown in a look-up table can be used efficiently, and it has the operation that an easy circuit design becomes possible.

[0029]Hereafter, an embodiment of the invention is described using drawing 17 from drawing 1.

[0030](Embodiment 1) Drawing 1 is a block diagram showing the composition of the sending set by this embodiment. In drawing 1, as for a guard aedeagus and 5, a mapping machine and 3 are [LPF and 9] transmission antennas a quadrature modulation machine and 8 an IDFT machine and 4 a S/P converter and 2, and, as for 1, these perform the same operation as that for which the same numerals were attached with the sending set shown in drawing 18 explained by the Prior art.

[0031]The sending set of drawing 1 arranges the electric power change machine 10 which is a means which makes subcarrier electric power in the direction of an end smaller than near the center of a signal band in the latter part of the mapping machine 2 in the conventional sending set of drawing 18.

[0032]Operation of the sending set of drawing 1 inputs the digital data inputted into the S/P converter 1, carries out serial/parallel conversion, performs signal point arrangement for abnormal conditions with the mapping machine 2, and makes subcarrier electric power in the direction of an end smaller than near the center of a signal band with the electric power change machine 10. And carry out inverse Fourier transform of the parallel signal with the IDFT machine 3, output a complex signal, and by the guard aedeagus 4. After copying a back portion to the head of a symbol among the complex signal symbols after inverse discrete Fourier transform, carry out quadrature modulation of the complex signal with which the guard interval was inserted with the quadrature modulation machine 5, and the image produced by quadrature modulation in LPF8 is removed, Electromagnetic waves are emitted to a radio transmission line as a sending signal from the transmission antenna 9.

[0033]Explanation of concrete operation of the electric power change machine 2 is shown below. The schematic diagram in which drawing 2 shows the frequency spectrum of the input signal to the electric power change machine 2, and drawing 3 are the schematic diagrams showing the frequency spectrum of the output signal from an electric power change machine. Here, N shows a subcarrier number and fs shows the subcarrier frequency interval.
[0034]Although the input signal has a spectrum of a uniform level in the signal band like drawing 2, it outputs the signal which made small electric power of the signal of the end part of a signal band which affects frequency spectrum out of band greatly like drawing 3 at the time of an output.
[0035]As an example of the concrete composition of the electric power change machine 2, it has the correlation table of an output to an input, and the power can be converted by making it operate so that the signal according to the level of the input signal may be chosen and outputted, for example.
[0036]Since the level of frequency spectrum out of band can be pressed down by having a means to change such electric power, frequency effective use is realizable in simple.
[0037]An electric power change machine in the parallel signal which the signal by which quadrature modulation was carried out inputs into the inverse discrete Fourier transform machine beforehand as the subcarrier electric power in the direction of an end is small rather than near the center of a zone, Since it is a means to change the electric power of what influences the electric power of the signal after quadrature modulation, it is also possible to give this function to the mapping machine 2 of the preceding paragraph.
[0038](Embodiment 2) Drawing 4 is a block diagram showing the composition of the receiving set by this embodiment, and receives the signal transmitted with the sending set of (Embodiment 1). In drawing 4, 11 a receiving antenna and 12 a band-pass filter and 13 Orthogonal demodulators, As for a guard removal machine and 17, 15 is [a demapping machine and 19] P/S converters the discrete Fourier transform (DFT) machine and 18 an A/D converter and 16, and these perform the same operation as that for which the same numerals were attached with the receiving set shown in drawing 18 explained by the Prior art.
[0039]In the latter part of the orthogonal demodulators 13 in the conventional receiving set of drawing 18, the receiving set of drawing 4 arranges the zone selection amplifier 100 which is a means which makes subcarrier electric power in the direction of an end larger than near the center of a signal band at the same time it gives the characteristic of a low pass filter to image removal.
[0040]Operation of the receiving set of drawing 4 receives the electromagnetic waves on a radio transmission line with the receiving antenna 11, Carry out orthogonal demodulation of the high frequency signal by the orthogonal demodulators 13, the band-pass filter 12 removes a desired ingredient out of band, change into a low-pass signal, and with the zone selection amplifier 100. Are in the direction of the end of a signal band and the frequency component of the subcarrier transmitted with small electric power is amplified at the same time it removes an image component, Being near the center of a signal band, the frequency component of the subcarrier transmitted with large electric power passes the filter which has a frequency characteristic which is not made to amplify.
[0041]And an analog signal is changed into a digital signal with A/D converter 15, The guard interval inserted in the transmitting side with the guard removal machine 16 is

removed, It changes into received data by the DFT machine's 17 performing discrete Fourier transform from an in-phase signal and a rectangular signal, and the demapping machine's 18 performing demapping corresponding to mapping of the transmitting side, and changing a parallel signal into a serial signal with the P/S converter 19.
[0042]Explanation of concrete operation of the zone selection amplifier 100 is shown below. The schematic diagram showing the characteristic of the low pass filter for image removal of the former [drawing 5] and drawing 6 are the schematic diagrams showing the characteristic of the zone selection amplifier 100 used by this embodiment. Here, N shows a subcarrier number and fs shows the subcarrier frequency interval.
[0043]Since the signal transmitted from the conventional sending set has spectral shape like drawing 2, in the low pass filter of the conventional receiving set, as shown in drawing 5, the electric power outside a signal band is only prevented, and a portion out of band has spectral characteristics with a certain amount of inclination like drawing 5 actually. However, since the signal which has frequency spectrum shape like drawing 3 at the transmitting side is transmitted in this embodiment, Like drawing 6, are in the direction of the end of a signal band and the frequency component of the subcarrier transmitted with small electric power is amplified, It is passing the signal which it is near the center of a signal band, and the frequency component of the subcarrier transmitted with large electric power arranges the zone selection amplifier 100 with the filter which has a frequency characteristic which is not amplified, and has a spectrum like drawing 3, The signal of a uniform level can be acquired within a zone.
[0044]It becomes possible to decrease the operation error produced by fixed-point arithmetic, without being able to improve the dynamic range of A/D converter 15 arranged in the latter part by providing a means to have such a function, or the discrete Fourier transform device 17, and changing C/N of each subcarrier.
[0045](Embodiment 3) Drawing 7 is a block diagram showing a part of input stage of the sending set by this embodiment. In drawing 7, the importance investigation machine with which 20 investigates the importance of input data, and 21 are importance consideration S/P converters which operate based on the result of the importance investigation machine 20, and it is inserted in the preceding paragraph of the mapping machine 2. The composition after the mapping machine 2 is the same as that of drawing 1.
[0046]Operation of the input stage of the sending set shown in drawing 7 inputs input data and contents into the importance investigation machine 20, investigates importance, and is the importance consideration S/P converter 21, The signal band of the subcarrier transmitted according to the level of importance is chosen, the signal with high importance is transmitted near the center of the large signal band of subcarrier electric power, and the signal with low importance forms the frequency spectrum of a sending signal so that it may transmit at the end of the small signal band of subcarrier electric power.
[0047]Drawing 8 is a schematic diagram showing the relation of the frequency spectrum and signal importance by S/P conversion with the importance consideration S/P converter 21. Thus, the frequency spectrum of a sending signal is formed so that the signal with high importance may be transmitted near the center of the large signal band of subcarrier electric power and the signal with low importance may be transmitted at the end of the small signal band of subcarrier electric power.
[0048]In a receiver, it becomes possible to output the usual received-data series by

performing P/S conversion corresponding to the importance consideration S/P conversion defined at the transmitting side. This importance consideration S/P conversion method can define the information on importance by the transmitting side and a receiver beforehand, or can transmit the information on a S/P converting method from the transmitting side to a receiver, and can also change the information on the importance of an importance consideration S/P conversion method if needed.
[0049]When performing FEC (Forward Error Correct) for correcting a transmission error here, it is also possible to perform FEC independently at given importance, and it is also possible to perform FEC in consideration of the signal series after importance consideration S/P conversion.
[0050](Embodiment 4) Drawing 9 is a block diagram showing the composition of the transmitter by this embodiment. In drawing 9, as for 101, a receiving set and 103 are sending sets a transmitter and 102, and other numerals are the same as that of what was used by drawing 8 from drawing 1. In this embodiment, transmit the frequency characteristic of the transmission line acquired by DFT17 of the receiving set 102 to the transmitting side, and on a basis this transmission-line-frequency characteristic in a sending set. The electric power of each subcarrier is changed in the electric power change machine 10, and it constitutes so that the subcarrier which transmits according to the importance of a signal can be chosen, and the S/P conversion method of the importance consideration S/P converter 21 can be changed.
[0051]By having such composition, by frequency selective fading etc., among the received signals, for example when the electric power of a certain subcarrier is small, In the electric power change machine 10, enlarge electric power of the subcarrier, and. The signal with high importance can form the signal according to the importance of the signal while it can be changed with the importance consideration S/P converter 21 and can make a subcarrier a suitable size so that it may transmit by another subcarrier.
[0052]By this embodiment, the more reliable transmission systems which can follow change of a transmission line can be built by forming the sending set and receiving set of the above composition.
[0053](Embodiment 5) Drawing 10 is a block diagram showing the composition of the sending set by this embodiment. In drawing 10, a sending set, The electric power change machine 10 which changes the output power of the numerical control oscillators 22 (NCO:Numerically Controlled Oscillator) for a subcarrier number, these inphases, and a quadrature component, and the in-phase component of this output. It has adding machine 23' adding a part for the adding machine 23 and an orthogonality to add, and the symbol timing generator 24. About other numerals, it is the same as that of what was used by drawing 9 from drawing 1.
[0054]Drawing 11 is a block diagram showing the composition of the numerical control oscillator 22 of the sending set of drawing 10. The numerical control oscillator 22 sets up an initial phase by the initial phase setting device 28 based on the output signal of the mapping machine 2 for every symbol timing from the symbol timing generator 24. The fixed phase value deltaphi25 based on the frequency of each subcarrier is delayed with the delay device 27, and the accumulator 26 accumulates it.
[0055]And in the omission machine 29, accumulated is omitted according to the address length of ROM30 following the latter part after the initial phase set up by the initial phase setting device 28, and a means to add an accumulator value. The value of ROM which

makes an address this omitted accumulated is read as amplitude value. Here, the inphase and the quadrature component are memorized by ROM and both ingredients are outputted. When there is change of amplitude like a quadrature amplitude modulation (QAM) method, with the amplitude change machine 31 in the latter part of ROM30, amplitude is changed and it corresponds.

[0056]If the initial phase 28 based on the output signal of the mapping machine 2 is set up for every symbol timing here, since a steep change of a phase arises, the spectrum outside a signal band will become large. Then, it does not change into an instant to the initial phase based on the output of the mapping machine 2, but is made to change to it gradually in the initial phase setting device 28. Change of amplitude is similarly changed gradually with the amplitude change machine 31. These initial phase setting device 28 and the amplitude change machine 31 operate with the signal from the symbol timing generator 24 synchronizing with symbol timing.

[0057]Thus, when change of a phase or amplitude becomes loose, spectrum out of band can be made small. Since the numerical control oscillator is used, the rectangular conditions between subcarriers are also easily and correctly satisfying.

[0058](Embodiment 6) Drawing 12 is a block diagram showing the composition of the numerical control oscillator of the sending set by this embodiment. In drawing 12, the numerical control oscillator 33 is constituted using the phase step machine 32, the accumulator 26, the delay device 27, the omission machine 29, ROM30, and the amplitude change machine 31, and inputs the signal from the mapping machine 2 and the symbol timing generator 24.

[0059]The phase step machine 32 of numerical control oscillator 33 inside changes phase step deltaphi (t) gradually in order to ease the steep change of an initial phase based on the mapping machine 2 according to the timing from the symbol timing generator 24.

[0060]That is, in order to ease the steep phase change for every symbol timing, the value of the accumulator 26 is changed gradually. Therefore, it is made to change to change of the initial phase instead of constant value gradually with phase step deltaphi (t) in the phase step machine 32. This change is performed based on the signal from the symbol timing generator 24.

[0061]Thus, a steep phase change can be eased by changing the value of the accumulator 26, and it becomes possible to make spectrum out of band small.

[0062](Embodiment 7) Drawing 13 is a block diagram showing some sending sets of the numerical control oscillator circumference by this embodiment. It is characterized by having the coefficient-of-variable-capacitance setting device 35, and the effect of this invention is presented with being constituted with the symbol timing generator 24, the numerical control oscillator (NCO) 22, the mapping machine 2, and the multiplier 34.

[0063]The coefficient-of-variable-capacitance setting device 35 is controlled to make the value of the coefficient of variable capacitance by which the complex signal from NCO22 is multiplied increase gradually as a means to provide the lamp section usually used, in order to ease the phase discontinuity between symbols (or reduction).

[0064]The timing to which the value of a coefficient of variable capacitance is changed gradually is synchronized with the signal from the symbol timing generator 24. And a means to make the value of a coefficient of variable capacitance increase gradually at the head of the symbol section, and to decrease the value of a coefficient of variable capacitance gradually in the end of the symbol section is used.

[0065]With such simple composition, it becomes possible to make spectrum out of band small.
[0066](Embodiment 8) Drawing 14 is a block diagram showing the outline composition of the numerical control oscillator of the sending set by this embodiment. In drawing 14, an amplitude change machine and 35 (35, 35, --) are an address determination part and share ROM whose 36 is a memory measure, and 31 (31, 31, --) corresponds to the numerical control oscillator of drawing 11 or drawing 12.
[0067]Drawing 15 is a block diagram showing an example of the concrete composition of the address determination part 35 in drawing 14, respectively, and each numerals are the same as that of what was used by drawing 11 or drawing 12.
[0068]Share ROM36 outputs the value corresponding to the address determined by the address determination part 35. The time sharing of the timing which inputs an address into share ROM36 is carried out, and it is kept from colliding between each NCO.
[0069]Since big ROM of circuit structure is sharable by having such composition between each NCO, reduction of circuit structure can be aimed at.
[0070](Embodiment 9) Drawing 16 is a block diagram showing the outline composition of the numerical control oscillator of the sending set by this embodiment. In drawing 16, the memory measure for which an amplitude change machine and 35 (35, 35, --) have an address determination part, 37 has an input bus, and 38 has share ROM and a control device, and 39 are output buses, and 31 (31, 31, --) corresponds to the numerical control oscillator of drawing 11 or drawing 12.
[0071]The memory measure 38 outputs the value corresponding to the address value from the input bus 37 to the output bus 39. Specifically to the input bus 37, they are each address determination parts 35, 35, and 35. -- The address value by which time sharing was carried out in between is inputted, A control device inputs a signal bunch from the input bus 37, a correspondence value is extracted from share ROM, it has composition which carries out parallel processing and is outputted to the output bus 39, and the address is kept from colliding.
[0072]Share ROM which is the look-up table currently shared between having such composition can be used efficiently, and an easy circuit design becomes possible.
[0073](Embodiment 10) Drawing 17 is a block diagram showing the outline composition of the numerical control oscillator of the sending set by this embodiment. In drawing 17, 31 (31, 31, --), as for an amplitude change machine and 35 (35, 35, --), share ROM and 40 are address shift machines, and an address coincidence detector and 41 correspond to the numerical control oscillator of drawing 11 or drawing 12 an address determination part and 36.
[0074]According to this embodiment, each address value determined by the address determination part 35 is compared in the address coincidence detector 41, and when in agreement, in the address shift machine 41, only constant value shifts an address value for congruous addresses in accordance with a certain random rule.
[0075]Thus, by adjusting an address, share ROM36 can be used efficiently. Since the same address value is not simultaneously inputted into share ROM36 by the address coincidence detector 40 and the address shift machine 41, ROM becomes possible [outputting the value corresponding to the inputted address value simultaneously] with them.

[0076]Although drawing 17 shows the case where share ROM36 is used, it is possible to carry out similarly, even when using the memory measure shown by (Embodiment 9).

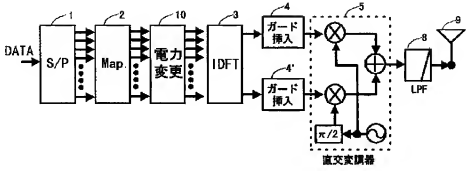
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The block diagram showing the composition of the sending set by the 1 embodiment of this invention
[Drawing 2]The schematic diagram showing the frequency spectrum of the input signal of the electric power change machine by the 1 embodiment of this invention
[Drawing 3]The schematic diagram showing the frequency spectrum of the output signal of the electric power change machine by the 1 embodiment of this invention
[Drawing 4]The block diagram showing the composition of the receiving set by the 1 embodiment of this invention
[Drawing 5]The schematic diagram showing the frequency spectrum characteristic of the conventional low pass filter for image removal
[Drawing 6]The schematic diagram showing the frequency spectrum characteristic of the zone selection amplifier by the 1 embodiment of this invention
[Drawing 7]The block diagram showing the composition of a part of input stage of the sending set by the 1 embodiment of this invention
[Drawing 8]The schematic diagram showing the relation of the frequency spectrum and signal importance by S/P conversion with an importance consideration S/P converter by the 1 embodiment of this invention
[Drawing 9]The block diagram showing the composition of the transmitter by the 1 embodiment of this invention
[Drawing 10]The block diagram showing the composition of the sending set by the 1 embodiment of this invention
[Drawing 11]The block diagram showing the composition of the numerical control oscillator in the sending set by the 1 embodiment of this invention
[Drawing 12]The block diagram showing the composition of the numerical control oscillator in the sending set by the 1 embodiment of this invention
[Drawing 13]The block diagram showing the composition of the part of the numerical control oscillator circumference in the sending set by the 1 embodiment of this invention
[Drawing 14]The block diagram showing the outline composition of the numerical control oscillator of the sending set by the 1 embodiment of this invention
[Drawing 15]The block diagram showing the composition of the address determination part in the numerical control oscillator by the 1 embodiment of this invention
[Drawing 16]The block diagram showing the outline composition of the numerical control oscillator of the sending set by the 1 embodiment of this invention
[Drawing 17]The block diagram showing the outline composition of the numerical control oscillator of the sending set by the 1 embodiment of this invention
[Drawing 18]The block diagram showing the composition of the sending set by the conventional OFDM system, and a receiving set
[Description of Notations]
1 S/P (serial/parallel) converter

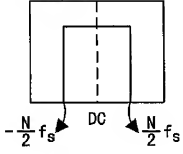
2 Mapping machine
3 IDFT (inverse discrete Fourier transform) machine
4 Guard aedeagus
5 Quadrature modulation machine
6 Band-pass filter
7 Up converter
8 Low pass filter
9 Transmission antenna
10 Electric power change machine
11 Receiving antenna
12 Band-pass filter
13 Orthogonal demodulators
14 Low pass filter
15 A/D (analog/digital) converter
16 Guard removal machine
17 DFT (discrete Fourier transform) machine
18 Demapping machine
19 P/S (parallel/serial) converter
20 Importance investigation machine
21 Importance consideration S/P converter
22 Numerical control oscillator (NCO)
23 Adding machine
24 Symbol timing generator
25 Fixed phase output machine
26 Accumulator
27 Delay device
28 Initial phase generator
29 Omission machine
30 ROM
31 Amplitude change machine
32 Variable-phase step generator
33 Numerical control oscillator (NCO)
34 Multiplier
35 Coefficient-of-variable-capacitance setting device
36 Share ROM
37 Input bus
38 Memory measure
39 Output bus
40 Address coincidence detector
41 Address shift machine
100 Zone selection amplifier
101 Transmitter
102 Receiving set
103 Sending set

DRAWINGS

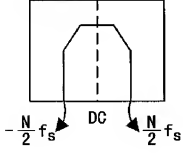
[Drawing 1]



[Drawing 2]



[Drawing 3]



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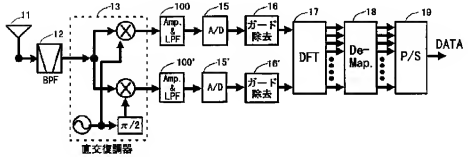
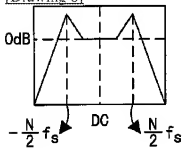
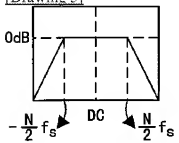


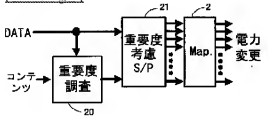
[Drawing 6]



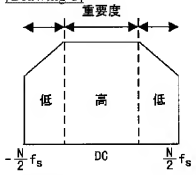
[Drawing 5]



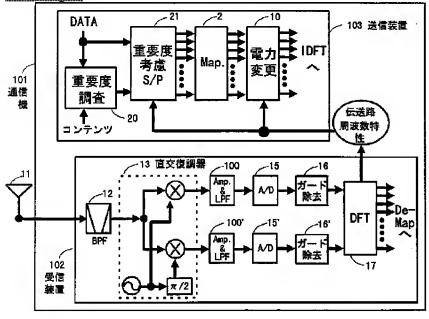
[Drawing 7]



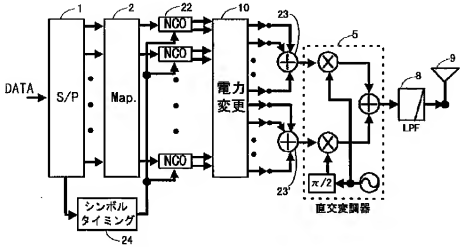
[Drawing 8]



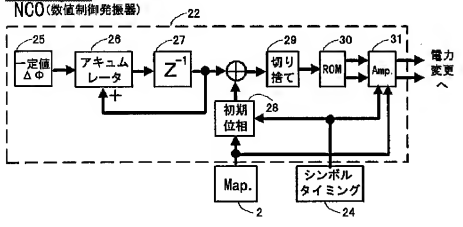
[Drawing 9]



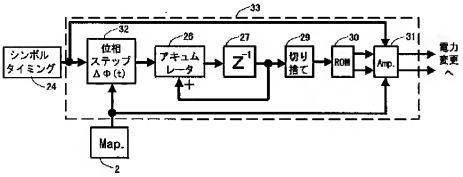
[Drawing 10]



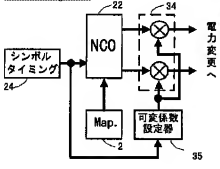
[Drawing 11]



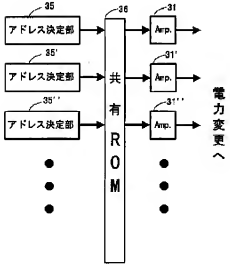
[Drawing 12]



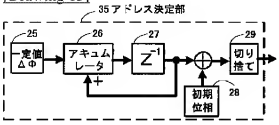
[Drawing 13]

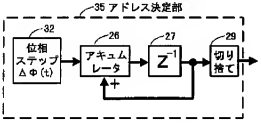


[Drawing 14]

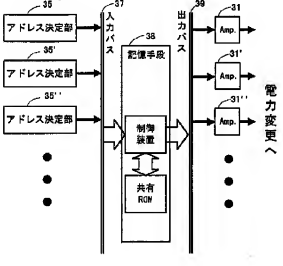


[Drawing 15]

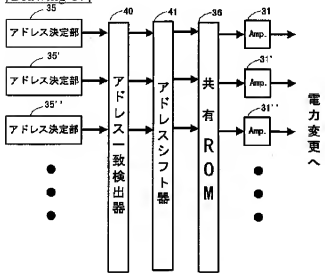




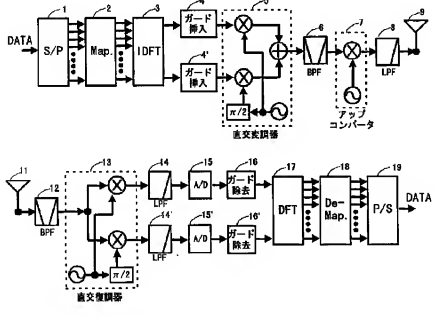
[Drawing 16]



[Drawing 17]



[Drawing 18]



(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（A）**　(11)特許出願公開番号
特開2000－269918
（P2000－269918A）
(43)公開日　平成12年９月29日(2000.9.29)

(51)Int.Cl.⁷	識別記号	ＦＩ	ﾃｰﾏｺｰﾄﾞ(参考)
Ｈ０４Ｊ　11/00		Ｈ０４Ｊ　11/00	Ｚ　５Ｋ０２２

審査請求　未請求　請求項の数14　ＯＬ　（全 13 頁）

(21)出願番号　特願平11－69775

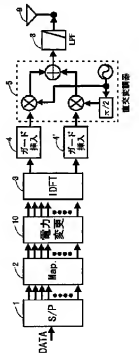
(22)出願日　平成11年３月16日(1999.3.16)

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地
(72)発明者　四方　英邦
神奈川県川崎市多摩区東三田３丁目10番１号　松下技研株式会社内
(72)発明者　山本　裕理
神奈川県川崎市多摩区東三田３丁目10番１号　松下技研株式会社内
(74)代理人　100097445
弁理士　岩橋　文雄　（外２名）

最終頁に続く

(54)【発明の名称】　直交周波数分割多重伝送方式とそれを用いた送信装置及び受信装置

(57)【要約】
【課題】　信号帯域外のスペクトル成分を簡易的な方法で十分に抑圧することで周波数を有効に利用できるＯＦＤＭ伝送方式とそれを用いた送信装置及び受信装置を実現することを目的とする。
【解決手段】　マッピング器２で信号点配置された各サブキャリアを電力変更器１０へ入力し、信号帯域内で中心周波数から一定周波数幅以上離れた領域では、サブキャリア電力を前記中心周波数から離れるにしたがって徐々に小さくするような勾配を有するように周波数スペクトル形状を形成することで、簡易な方法で周波数を有効に利用できる。



【特許請求の範囲】

【請求項１】　各サブキャリアが変調された直交周波数分割多重（ＯＦＤＭ）伝送方式を用いた通信方式において、信号帯域内で中心周波数から一定周波数幅以上離れた領域では、サブキャリア電力を前記中心周波数から離れるにしたがって徐々に小さくするような勾配を有するように周波数スペクトル形状が形成された通信信号を用いることを特徴とする直交周波数分割多重伝送方式。

【請求項２】　信号帯域内で中心周波数から一定周波数幅以上離れた領域のサブキャリア電力を、中心周波数から離れるにしたがって徐々に小さくする電力変更手段を有することを特徴とする請求項１記載の直交周波数分割多重伝送方式を用いた送信装置。

【請求項３】　信号帯域内で中心周波数から一定周波数幅以上離れた領域のサブキャリア電力を中心周波数から離れるにしたがって徐々に大きくするとともに、前記信号帯域外の周波数領域の信号を除去するフィルタ機能をもつ帯域選択増幅手段を有することを特徴とする請求項１記載の直交周波数分割多重伝送方式を用いた受信装置。

【請求項４】　通信信号は、重要度に応じて選択されたサブキャリアにより形成されたことを特徴とする請求項１記載の直交周波数分割多重伝送方式。

【請求項５】　通信信号は、重要度が低いと判断されたサブキャリアほど中心周波数から離れた周波数スペクトル領域に配置して形成されたことを特徴とする請求項４記載の直交周波数分割多重伝送方式。

【請求項６】　通信信号は、伝送路周波数特性情報が含まれていることを特徴とする請求項４または５記載の直交周波数分割多重伝送方式。

【請求項７】　請求項４または５記載の直交周波数分割多重伝送方式を用い、送信データとコンテンツ情報とを入力し各サブキャリアの重要度を判定して重要度情報を出力する重要度調査手段と、前記送信データと前記重要度情報とを入力し前記重要度情報を基にサブキャリアを選択してシリアル／パラレル（Ｓ／Ｐ）変換を行う重要度考慮Ｓ／Ｐ変換手段とを有することを特徴とする請求項２記載の送信装置。

【請求項８】　請求項６記載の直交周波数分割多重伝送方式を用い、送信データとコンテンツ情報とを入力し各サブキャリアの重要度を判定して重要度情報を出力する重要度調査手段と、前記送信データと前記重要度情報と伝送路周波数特性情報とを入力し且つ前記重要度情報と前記伝送路周波数特性情報とを基にサブキャリアを選択してシリアル／パラレル（Ｓ／Ｐ）変換を行う重要度考慮Ｓ／Ｐ変換手段とを有し、電力変更器が前記伝送路周波数特性情報を基にサブキャリア電力の変更を行うことを特徴とする請求項２記載の送信装置。

【請求項９】　タイミング信号とサブキャリアとを入力し前記サブキャリアに応じて同相成分及び直交成分のサブキャリア電力を出力する数値制御発振器（ＮＣＯ）をサブキャリア本数分備え、前記同相成分及び直交成分のサブキャリア電力の電力値を変更する電力変更器と、変更後の同相成分の電力値を加算する第１加算器と、変更後の直交成分の電力値を加算する第２加算器と、前記第１加算器の出力及び前記第２加算器の出力を入力して直交変調を行う直交変調器とを有することを特徴とする請求項２記載の送信装置。

【請求項１０】　数値制御発振器は、位相の変化が時間的に緩やかで連続的な変化となるような位相ステップ値を出力する位相ステップ発生器と、前記位相ステップ値を加算するアキュムレータとを有することを特徴とする請求項９記載の送信装置。

【請求項１１】　タイミング信号に基づいて可変係数を発生する可変係数設定器と、数値制御発振器の出力に前記可変係数を乗じる乗算器とを有し、振幅の変化が時間的に緩やかに増幅または減衰するように前記可変係数設定器を制御することを特徴とする請求項９または１０記載の送信装置。

【請求項１２】　数値制御発振器は、サブキャリアに対応したアドレス値を決定するアドレス決定手段と、サブキャリア本数分の全ての数値制御発振器で共有化された前記アドレス値に基づいて値を選択し出力する記憶手段とを有することを特徴とする請求項９から１１のいずれかに記載の送信装置。

【請求項１３】　数値制御発振器は、サブキャリアに対応したアドレス値を決定するアドレス決定手段と、サブキャリア本数分の全ての数値制御発振器で共有化された全てのアドレス値を入力し一致したものがないかを判定して判定値を出力するアドレス一致検出手段と、前記判定値が一致情報を含む場合はアドレス値を必要量シフトして出力し、一致情報がない場合はそのままアドレス値を出力するアドレスシフト手段と、前記アドレスシフト手段からのアドレス値に基づいて値を選択し出力する記憶手段とを有することを特徴とする請求項９から１１記載の送信装置。

【請求項１４】　記憶手段は、入力に対応づけられた出力値を保存したＲＯＭと、全てのアドレス値を入力しそれぞれに基づいて前記ＲＯＭからそれぞれ対応する値を抽出して並列出力する制御手段とを有することを特徴とする請求項１２または１３記載の送信装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、無線通信に用いられる、各サブキャリアが変調された直交周波数分割多重（ＯＦＤＭ）伝送方式とそれを用いた送信装置及び受信装置に関する。

【０００２】

【従来の技術】従来、ＯＦＤＭ信号を無線伝送する場合、隣接する無線周波数のチャネルに悪影響を与えるこ

とのないよう、信号帯域外のスペクトルを十分抑圧する必要があり、高周波回路等で用いる帯域通過フィルタで抑圧させたりしていた。帯域通過フィルタを使用する場合は中心周波数を可変にすることが困難なため、所望の無線周波数チャネルで送信するためには、帯域通過フィルタ出力をアップコンバートした後に、さらに低域通過フィルタまたは高域通過フィルタ等によってイメージ周波数を抑圧する必要があり、回路規模が大きいという欠点を有していた。

【０００３】また、ＯＦＤＭ信号の特徴を利用し、信号帯域の端のサブキャリアほど中心付近のサブキャリアよりも伝送速度を遅くすることで、信号帯域外のスペクトルを抑圧する方法も知られている。しかしながら、このサブキャリアの伝送速度を変える方式でガードタイムを生成する場合、通常のＯＦＤＭ方式で行われているようなガードタイムの挿入方法を用いることが不可能である。すなわち、通常のガードタイム挿入方法は、逆離散フーリエ変換後のシンボルのうち、後ろの部分をシンボルの先頭にコピーする方法が用いられているが、サブキャリアの伝送速度を変える方式の場合は、伝送速度が遅いサブキャリアについては別に逆離散フーリエ変換を実施しておき、伝送速度が早いサブキャリアのみで生成したガードタイムに加えるという付加的な処理が必要となってしまい、回路規模が大きくなってしまう。

【０００４】以下に、従来の送信装置、及び受信装置を簡単に説明する。

【０００５】図１８に従来のＯＦＤＭ送受信装置の構造を示す。送信装置では、送信すべきシリアルデータをパラレルデータにＳ／Ｐ変換器１で変換した後、マッピング器２で縦形変調用のマッピングが施される。後段に続く逆離散フーリエ変換器（ＩＤＦＴ）３は逆離散フーリエ変換を実施し、ガード挿入器４において、シンボルの後ろの部分がシンボルの先頭にコピーされる。続いて直交変調器５によって直交変調された後、中心周波数が一定の帯域通過フィルタ（ＢＰＦ）６で信号帯域外のスペクトルを抑圧する。

【０００６】その後、送信すべき無線周波数チャネルの周波数に一致させるためにアップコンバータ７でアップコンバートされ、イメージを除去するために低域通過フィルタ８を通過して、アンテナ９から無線伝送路に放射される。

【０００７】受信装置では、アンテナ１１で受信した信号のうち、所望の帯域以外の成分を帯域通過フィルタ１２で除去し、後段の直交復調器１３に入力する。直交復調器１３の後段には、直交復調器で生ずるイメージを除去するための、低域通過フィルタ１４が用いられる。従来は、この低域通過フィルタ１４はイメージ除去用であるため、信号帯域内で増幅させる特性は有していなかった。

【０００８】次に、Ａ／Ｄ変換器１５によってディジタル信号に変換された後に、送信側で挿入されたガード区間をガード除去器１６によって除去した後、離散フーリエ変換器（ＤＦＴ）１７によって周波数領域の信号に変換される。次に、送信側のマッピングに対応するデマッピング器１８によって復調された後、Ｐ／Ｓ変換器１９によって受信データが出力される構成となっている。

【０００９】

【発明が解決しようとする課題】ＯＦＤＭ伝送方式の信号を無線伝送する場合、従来の方式及び装置では、上記のように複雑な回路が必要となり、回路規模が大きくなってしまう。しかしながら限られた周波数を有効に利用するために、簡易的な方法で信号帯域外のスペクトル成分を十分に抑圧しておくことが望ましい。

【００１０】本発明は、信号帯域外のスペクトル成分を簡易的な方法で十分に抑圧することで周波数を有効に利用できるＯＦＤＭ伝送方式とそれを用いた送信装置及び受信装置を実現することを目的とする。

【００１１】

【課題を解決するための手段】この課題を解決するために本発明は、信号帯域内で中心周波数から一定周波数幅以上離れた領域では、サブキャリア電力を前記中心周波数から離れるにしたがって徐々に小さくするような勾配を有するように周波数スペクトル形状が形成された通信信号を用いる直交周波数分割多重伝送方式としたものである。

【００１２】また、このような直交周波数分割多重伝送方式を用いた送信装置を構成したものである。

【００１３】また、このような直交周波数分割多重伝送方式を用いた受信装置を構成したものである。

【００１４】これにより、簡易的な方法で信号帯域外スペクトルを小さくでき、周波数を有効に利用することが可能となる。

【００１５】

【発明の実施の形態】本発明の請求項１に記載の発明は、各サブキャリア電力が変調された直交周波数分割多重（ＯＦＤＭ）伝送方式を用いた通信方式において、信号帯域内で中心周波数から一定周波数幅以上離れた領域では、サブキャリア電力を前記中心周波数から離れるにしたがって徐々に小さくするような勾配を有するように周波数スペクトル形状が形成された通信信号を用いることを特徴とする直交周波数分割多重伝送方式であり、簡易な方法で周波数を有効に利用できるという作用を有する。

【００１６】請求項２に記載の発明は、信号帯域内で中心周波数から一定周波数幅以上離れた領域のサブキャリア電力を、中心周波数から離れるにしたがって徐々に小さくする電力変更手段を有することを特徴とする請求項１記載の直交周波数分割多重伝送方式を用いた送信装置であり、簡易な構成で周波数を有効に利用できるという作用を有する。

【0017】請求項3に記載の発明は、信号帯域内で中心周波数から一定周波数幅以上離れた領域のサブキャリア電力を中心周波数から離れるにしたがって徐々に大きくするとともに、前記信号帯域外の周波数領域の信号を除去するフィルタ機能をもつ帯域選択増幅手段を有することを特徴とする請求項1記載の直交周波数分割多重伝送方式を用いた受信装置であり、各サブキャリアのC／N（搬送波電力対雑音比）を変化させることなく、後段に続く離散フーリエ変換器等のダイナミックレンジを改善させることができ、簡易な構成で周波数を有効に利用できるという作用を有する。

【0018】請求項4に記載の発明は、通信信号は、重要度に応じて選択されたサブキャリアにより形成されたことを特徴とする請求項1記載の直交周波数分割多重伝送方式であり、重要度に応じたサブキャリアによりスペクトルを構成することで柔軟な伝送システムを構築できるという作用を有する。

【0019】特に、請求項5に記載の発明のように、通信信号が、重要度が低いと判断されたサブキャリアほど中心周波数から離れた周波数スペクトル領域に配置して形成されたことを特徴とする請求項4記載の直交周波数分割多重伝送方式とすれば、重要度の高い信号はサブキャリア電力の大きい信号帯域の中心付近で伝送し、重要度の低い信号はサブキャリア電力の小さい信号帯域の端で伝送することで、信号の重要度に応じた伝送品質を確保することができるという作用を有する。

【0020】請求項6に記載の発明は、通信信号が、伝送路周波数特性情報が含まれていることを特徴とする請求項4または5記載の直交周波数分割多重伝送方式であり、伝送路の変化に追従したより信頼性の高い伝送システムを構築できるという作用を有する。

【0021】請求項7に記載の発明は、請求項4または5記載の直交周波数分割多重伝送方式を用い、送信データとコンテンツ情報とを入力し各サブキャリアの重要度を判定して重要度情報を出力する重要度調査手段と、前記送信データと前記重要度情報とを入力し前記重要度情報を基にサブキャリアを選択してシリアル／パラレル（S／P）変換を行う重要度考慮S／P変換手段とを有することを特徴とする請求項2記載の送信装置であり、重要度に応じたサブキャリアによりスペクトルを構成することで、柔軟な伝送システムを構築するための送信装置を形成できるという作用を有する。

【0022】請求項8に記載の発明は、請求項6記載の直交周波数分割多重伝送方式を用い、送信データとコンテンツ情報とを入力し各サブキャリアの重要度を判定して重要度情報を出力する重要度調査手段と、前記送信データと前記重要度情報と伝送路周波数特性情報とを入力し且つ前記重要度情報と前記伝送路周波数特性情報とを基にサブキャリアを選択してシリアル／パラレル（S／P）変換を行う重要度考慮S／P変換手段とを有し、電力変更器が前記伝送路周波数特性情報を基にサブキャリア電力の変更を行うことを特徴とする請求項2記載の送信装置であり、周波数選択性フェージング等の伝送路状況においても、伝送路の周波数特性変化に追従できるより信頼性の高い送信装置を形成できるという作用を有する。

【0023】請求項9に記載の発明は、タイミング信号とサブキャリアとを入力し前記サブキャリアに応じて同相成分及び直交成分のサブキャリア電力を出力する数値制御発振器（NCO）をサブキャリア本数分備え、前記同相成分及び直交成分のサブキャリア電力の電力値を変更する電力変更器と、変更後の同相成分の電力値を加算する第1加算器と、変更後の直交成分の電力値を加算する第2加算器と、前記第1加算器の出力及び前記第2加算器の出力を入力して直交変調を行う直交変調器とを有することを特徴とする請求項2記載の送信装置であり、サブキャリア間の直交条件を正確に満足しながら、信号帯域外スペクトルを抑圧できるという作用を有する。

【0024】請求項10に記載の発明は、数値制御発振器は、位相の変化が時間的に緩やかで連続的な変化となるような位相ステップ値を出力する位相ステップ発生器と、前記位相ステップ値を加算するアキュムレータとを有することを特徴とする請求項9記載の送信装置であり、簡易的な構成で信号帯域外スペクトルを抑圧できるという作用を有する。

【0025】請求項11に記載の発明は、タイミング信号に基づいて可変係数を発生する可変係数設定器と、数値制御発振器の出力に前記可変係数を乗じる乗算器とを有し、振幅の変化が時間的に緩やかに増幅または減衰するように前記可変係数設定器を制御することを特徴とする請求項9または10記載の送信装置であり、簡易的な構成で信号帯域外スペクトルを抑圧できるという作用を有する。

【0026】請求項12に記載の発明は、数値制御発振器は、サブキャリアに対応したアドレス値を決定するアドレス決定手段と、サブキャリア本数分の全ての数値制御発振器で共有化され前記アドレス値に基づいて値を選択し出力する記憶手段とを有することを特徴とする請求項9から11のいずれかに記載の送信装置であり、回路規模の大きな例えばルックアップテーブルのような記憶手段を共有することによって、送信装置の小型化が図れるという作用を有する。

【0027】請求項13に記載の発明は、数値制御発振器は、サブキャリアに対応したアドレス値を決定するアドレス決定手段と、サブキャリア本数分の全ての数値制御発振器で共有化され全てのアドレス値を入力し一致したものがないかを判定して判定値を出力するアドレス一致検出手段と、前記判定値が一致情報を含む場合はアドレス値を必要量シフトして出力し、一致情報がない場合はそのままアドレス値を出力するアドレスシフト手段

と、前記アドレスシフト手段からのアドレス値に基づいて値を選択し出力する記憶手段とを有することを特徴とする請求項９から１１記載の送信装置であり、共有している例えばルックアップテーブルのような記憶手段を効率よく利用できると同時に、ピーク電力を削減できるという作用を有する。

【００２８】請求項１４に記載の発明は、記憶手段は、入力に対応づけられた出力値を保存したＲＯＭと、全てのアドレス値を入力しそれぞれに基づいて前記ＲＯＭからそれぞれ対応する値を抽出して並列出力する制御手段とを有することを特徴とする請求項１２または１３記載の送信装置であり、共有している例えばルックアップテーブルのようなＲＯＭを効率よく利用でき、容易な回路設計が可能となるという作用を有する。

【００２９】以下、本発明の実施の形態について、図１から図１７を用いて説明する。

【００３０】（実施の形態１）図１は本実施の形態による送信装置の構成を示すブロック図である。図１において、１はＳ／Ｐ変換器、２はマッピング器、３はＩＤＦＴ器、４はガード挿入器、５は直交変調器、８はＬＰＦ、９は送信アンテナであり、これらは、従来の技術で説明した図１８に示す送信装置で同じ符号を付したものと同様の動作を行う。

【００３１】図１の送信装置は、図１８の従来の送信装置におけるマッピング器２の後段に、信号帯域の中心付近よりも端の方のサブキャリア電力を小さくする手段である電力変更器１０を配置したものである。

【００３２】図１の送信装置の動作は、入力されるディジタルデータをＳ／Ｐ変換器１に入力してシリアル／パラレル変換し、マッピング器２で変調用の信号点配置を行い、電力変更器１０で信号帯域の中心付近よりも端の方のサブキャリア電力を小さくする。そして、ＩＤＦＴ器３でパラレル信号を逆フーリエ変換して複素信号を出力し、ガード挿入器４で、逆離散フーリエ変換後の複素信号シンボルのうち後ろの部分をシンボルの先頭にコピーした後、直交変調器５でガード区間が挿入された複素信号を直交変調し、ＬＰＦ８で直交変調によって生じたイメージを除去して、送信アンテナ９より無線伝送路に送信信号として電磁波を放射する。

【００３３】電力変更器２の具体的な動作の説明を以下に示す。図２は電力変更器２への入力信号の周波数スペクトルを示す概略図、図３は電力変更器からの出力信号の周波数スペクトルを示す概略図である。ここで、Ｎはサブキャリア本数を示し、ｆｓはサブキャリア周波数間隔を示している。

【００３４】入力信号は、図２のように信号帯域内において一様なレベルのスペクトルを有しているが、出力時には、図３のように、帯域外の周波数スペクトルに大きく影響を与える、信号帯域の端部分の信号の電力を小さくした信号を出力する。

【００３５】電力変更器２の具体的な構成の一例としては、例えば、入力に対する出力の相関テーブルを備えておき、入力信号のレベルに応じた信号を選択し出力するように動作させることで、電力変換を行うことができる。

【００３６】このような電力を変換する手段を有することにより、帯域外の周波数スペクトルのレベルを抑えることができるため、周波数有効利用を簡易的に実現できる。

【００３７】なお、電力変更器は、直交変調された信号が帯域の中心付近よりも端の方のサブキャリア電力が小さくなっているように、予め、逆離散フーリエ変換器に入力するパラレル信号の中で、直交変調後の信号の電力に影響するものの電力を変換する手段であるので、前段のマッピング器２にこの機能を持たせることも可能である。

【００３８】（実施の形態２）図４は本実施の形態による受信装置の構成を示すブロック図であり、（実施の形態１）の送信装置で送信された信号を受信する。図４において、１１は受信アンテナ、１２は帯域通過フィルタ、１３は直交復調器、１５はＡ／Ｄ変換器、１６はガード除去器、１７は離散フーリエ変換（ＤＦＴ）器、１８はデマッピング器、１９はＰ／Ｓ変換器であり、これらは、従来の技術で説明した図１８に示す受信装置で同じ符号を付したものと同様の動作を行う。

【００３９】図４の受信装置は、図１８の従来の受信装置における直交復調器１３の後段に、イメージ除去用に低域通過フィルタの特性を持たせると同時に、信号帯域の中心付近よりも端の方のサブキャリア電力を大きくする手段である帯域選択増幅器１００を配置したものである。

【００４０】図４の受信装置の動作は、受信アンテナ１１で無線伝送路上の電磁波を受信し、帯域通過フィルタ１２で所望の帯域外の成分を除去し、直交復調器１３で高周波信号を直交復調して低域信号に変換し、帯域選択増幅器１００で、イメージ成分を除去すると同時に、信号帯域の端の方にあって、小さい電力で送信されているサブキャリアの周波数成分を増幅し、信号帯域の中心付近にあって、大きい電力で送信されているサブキャリアの周波数成分は増幅させないような周波数特性を有するフィルタを通過させる。

【００４１】そして、Ａ／Ｄ変換器１５でアナログ信号をディジタル信号に変換し、ガード除去器１６で送信側において挿入されたガード区間を除去し、ＤＦＴ器１７で同相信号および直交信号から離散フーリエ変換を行い、デマッピング器１８で送信側のマッピングに対応したデマッピングを行い、Ｐ／Ｓ変換器１９でパラレル信号をシリアル信号に変換することによって、受信データへ変換する。

【００４２】帯域選択増幅器１００の具体的な動作の説

明を以下に示す。図5は従来のイメージ除去用低域通過フィルタの特性を示す概略図、図6は本実施の形態で用いる帯域選択増幅器１００のを特性を示す概略図である。ここで、Ｎはサブキャリア本数を示し、ｆｓはサブキャリア周波数間隔を示している。

【００４３】従来の送信装置から送信された信号は、図２のようなスペクトル形状を有しているため、従来の受信装置の低域通過フィルタでは、図５に示すように単に信号帯域外の電力を阻止し、実際には、図５のように帯域外の部分にある程度の勾配をもつスペクトル特性を有する。しかし、本実施の形態では、送信側で図３のような周波数スペクトル形状を有する信号が送信されているため、図６のように、信号帯域の端の方にあって、小さい電力で送信されているサブキャリアの周波数成分は増幅し、信号帯域の中心付近にあって、大きい電力で送信されているサブキャリアの周波数成分は増幅しないような周波数特性を有するフィルタを持つ帯域選択増幅器１００を配置して図３のようなスペクトルを有する信号を通過させることで、帯域内で一様なレベルの信号を得ることができる。

【００４４】このような機能を有する手段を具備することにより、後段に配置されたＡ／Ｄ変換器１５や離散フーリエ変換器１７のダイナミックレンジを改善でき、各サブキャリアのＣ／Ｎを変化させることなく、固定小数点演算によって生じる演算誤差を減少させることが可能となる。

【００４５】（実施の形態３）図７は本実施の形態による送信装置の入力段の一部を示すブロック図である。図７において、２０は入力データの重要度を調べる重要度調査器、２１は重要度調査器２０の結果に基づいて動作する重要度考慮Ｓ／Ｐ変換器であり、マッピング器２の前段に挿入される。マッピング器２以降の構成は、図１と同様である。

【００４６】図７に示す送信装置の入力段の動作は、入力データとコンテンツを重要度調査器２０に入力して重要度を調べ、重要度考慮Ｓ／Ｐ変換器２１で、重要度のレベルに応じて伝送するサブキャリアの信号帯域を選択し、重要度の高い信号はサブキャリア電力の大きい信号帯域の中心付近で伝送し、重要度の低い信号はサブキャリア電力の小さい信号帯域の端で伝送するように、送信信号の周波数スペクトルを形成する。

【００４７】図８は重要度考慮Ｓ／Ｐ変換器２１でのＳ／Ｐ変換による周波数スペクトルと信号重要度との関係を示す概略図である。このように、重要度の高い信号はサブキャリア電力の大きい信号帯域の中心付近で伝送し、重要度の低い信号はサブキャリア電力の小さい信号帯域の端で伝送するように、送信信号の周波数スペクトルが形成される。

【００４８】また、受信側では、送信側で定めた重要度考慮Ｓ／Ｐ変換に対応するＰ／Ｓ変換を施すことによって、通常の受信データ系列を出力することが可能となる。この重要度考慮Ｓ／Ｐ変換手段は、あらかじめ送信側と受信側で重要度の情報を定めておくことが可能であり、あるいは、送信側から受信側に対してＳ／Ｐ変換方法の情報を送信し、必要に応じて重要度考慮Ｓ／Ｐ変換手段の重要度の情報を変更することも可能である。

【００４９】ここで、伝送誤りを訂正するためのＦＥＣ（Forward Error Correct）を行う場合には重要度毎に別々にＦＥＣを行うことも可能であり、また、重要度考慮Ｓ／Ｐ変換後の信号系列を考慮したＦＥＣを行うことも可能である。

【００５０】（実施の形態４）図９は本実施の形態による通信機の構成を示すブロック図である。図９において、１０１は通信機、１０２は受信装置、１０３は送信装置であり、その他の符号は図１から図８で用いたものと同様である。本実施の形態では、受信装置１０２のＤＦＴ１７で得られる伝送路の周波数特性を送信側に送信し、この伝送路周波数特性を基に送信装置では、電力変更器１０において各サブキャリアの電力を変更すると共に、信号の重要度に応じて送信するサブキャリアを選択できるよう、重要度考慮Ｓ／Ｐ変換器２１のＳ／Ｐ変換手段を変更できるように構成する。

【００５１】このような構成とすることにより、例えば、周波数選択性フェージング等により、受信した信号のうちあるサブキャリアの電力が小さい場合には、電力変更器１０においてそのサブキャリアの電力を大きくすると共に、重要度の高い信号は別のサブキャリアで送信するよう、重要度考慮Ｓ／Ｐ変換器２１にて変更することができ、サブキャリアを適切な大きさにすることができるとともに信号の重要度に応じた信号を形成することができる。

【００５２】以上のような構成の送信装置及び受信装置を形成することにより本実施の形態では、伝送路の変化に追従できる、より信頼性の高い伝送システムを構築することができる。

【００５３】（実施の形態５）図１０は本実施の形態による送信装置の構成を示すブロック図である。図１０において送信装置は、サブキャリア本数分の数値制御発振器２２（ＮＣＯ：Numerically Controlled Oscillator）とこれらの同相および直交成分の出力電力を変更する電力変更器１０、ならびにこの出力の同相成分を加算する加算器２３及び直交性分を加算する加算器２３’、シンボルタイミング発生器２４を有している。その他の符号については、図１から図９で用いたものと同様である。

【００５４】また図１１は、図１０の送信装置の数値制御発振器２２の構成を示すブロック図である。数値制御発振器２２は、シンボルタイミング発生器２４からのシンボルタイミングごとに、マッピング器２の出力信号に基づいて初期位相設定器２８で初期位相を設定する。ア

キュムレータ26は、各サブキャリアの周波数に基づく一定の位相値ΔΦ25を、遅延器27で遅延させて累積する。

【0055】そして、初期位相設定器28で設定した初期位相とアキュムレータ値を加算する手段の後に、切り捨て器29において、後段に続くROM30のアドレス長に合わせて累積値を切り捨てる。この切り捨てられた累積値をアドレスとするROMの値を振幅値として読み出す。ここで、ROMには同相および直交成分が記憶されており、両方の成分が出力される。直交振幅変調（QAM）方式のように振幅の変化がある場合には、ROM30の後段にある振幅変更器31によって振幅を変化させて対応する。

【0056】ここで、シンボルタイミング毎にマッピング器2の出力信号に基づいた初期位相28を設定すると、位相の急峻な変化が生ずるため信号帯域外のスペクトラムが大きくなる。そこで、初期位相設定器28では、瞬時にマッピング器2の出力に基づく初期位相へ変えるのではなく、徐々に変化させる。また、振幅の変化も振幅変更器31によって同様に徐々に変化させる。これら初期位相設定器28および振幅変更器31は、シンボルタイミング発生器24からの信号によってシンボルタイミングに同期して動作する。

【0057】このように位相や振幅の変化が緩やかになることによって、帯域外スペクトラムを小さくすることができる。また、数値制御発振器を用いているため、容易かつ正確にサブキャリア間の直交条件も満足することができる。

【0058】（実施の形態6）図12は本実施の形態による送信装置の数値制御発振器の構成を示すブロック図である。図12において数値制御発振器33は、位相ステップ器32、アキュムレータ26、遅延器27、切り捨て器29、ROM30、振幅変更器31を用いて構成され、マッピング器2、シンボルタイミング発生器24からの信号を入力する。

【0059】数値制御発振器33内部の位相ステップ器32は、シンボルタイミング発生器24からのタイミングに従って、マッピング器2に基づく初期位相の急峻な変化を緩和するため、位相ステップΔΦ（t）を徐々に変化させるものである。

【0060】すなわち、シンボルタイミング毎の急峻な位相変化を緩和するために、アキュムレータ26の値を徐々に変化させる。そのため、位相ステップ器32において位相ステップΔΦ（t）を一定値でなく、初期位相の変化に伴って徐々に変化させる。この変化は、シンボルタイミング発生器24からの信号を基に行う。

【0061】このようにアキュムレータ26の値を変化させることで、急峻な位相変化が緩和でき、帯域外スペクトラムを小さくすることが可能となる。

【0062】（実施の形態7）図13は本実施の形態による送信装置の数値制御発振器周辺の一部を示すブロック図である。可変係数設定器35を有することを特徴とし、シンボルタイミング発生器24、数値制御発振器（NCO）22、マッピング器2、乗算器34とともに構成されることで本発明の効果を呈する。

【0063】可変係数設定器35は、シンボル間の位相不連続性を緩和するために通常用いられるランプ区間を設ける手段として、NCO22からの複素信号に乗ずる可変係数の値を徐々に増加（または減少）させるように制御する。

【0064】可変係数の値を徐々に変化させるタイミングは、シンボルタイミング発生器24からの信号に同期させる。そして、シンボル区間の先頭では可変係数の値を徐々に増加させ、シンボル区間の終わりでは可変係数の値を徐々に減少させる手段を用いる。

【0065】このような簡易な構成で、帯域外スペクトラムを小さくすることが可能となる。

【0066】（実施の形態8）図14は本実施の形態による送信装置の数値制御発振器の概略構成を示すブロック図である。図14において、31（，31’，31”，…）は振幅変更器、35（，35’，35”，…）はアドレス決定部、36は記憶手段である共有ROMであり、図11や図12の数値制御発振器に対応する。

【0067】図15は、それぞれ、図14におけるアドレス決定部35の具体的な構成の一例を示すブロック図であり、各符号は、図11や図12で用いたものと同様である。

【0068】共有ROM36は、アドレス決定部35で決定されたアドレスに対応する値を出力する。また、共有ROM36にアドレスを入力するタイミングは時分割しておき、各NCO間で衝突することがないようにしておく。

【0069】このような構成とすることで、回路規模の大きなROMを各NCO間で共有することができるため、回路規模の縮小を図ることができる。

【0070】（実施の形態9）図16は本実施の形態による送信装置の数値制御発振器の概略構成を示すブロック図である。図16において、31（，31’，31”，…）は振幅変更器、35（，35’，35”，…）はアドレス決定部、37は入力バス、38は共有ROMと制御装置とを有する記憶手段、39は出力バスであり、図11や図12の数値制御発振器に対応する。

【0071】記憶手段38は、入力バス37からのアドレス値に対応する値を出力バス39に出力する。具体的には、入力バス37へは各アドレス決定部35、35’、35”…間で時分割されたアドレス値が入力され、制御装置はその入力バス37から信号束を入力して共有ROMから対応値を抽出し、並列処理をして出力バス39へ出力する構成とし、アドレスが衝突することは

ないようにしておく。

【0072】このような構成とすることで、共有しているルックアップテーブルである共有ROMを効率よく利用でき、容易な回路設計が可能となる。

【0073】（実施の形態10）図17は本実施の形態による送信装置の数値制御発振器の概略構成を示すブロック図である。図17において、31（、31'、31"、…）は振幅変更器、35（、35'、35"、…）はアドレス決定部、36は共有ROM、40はアドレス一致検出器、41はアドレスシフト器であり、図11や図12の数値制御発振器に対応する。

【0074】本実施の形態では、アドレス決定部35によって決定された各アドレス値をアドレス一致検出器41において比較し、一致している場合にはアドレスシフト器41において、一致しているアドレスをランダム的またはある規則に従ってアドレス値を一定値だけずらす。

【0075】このようにアドレスを調整することによって、共有ROM36を効率よく利用することができる。また、アドレス一致検出器40およびアドレスシフト器41によって、同時に同じアドレス値が共有ROM36に入力されることがないため、ROMは入力されたアドレス値に対応する値を同時に出力することが可能となる。

【0076】なお、図17では共有ROM36を用いる場合を示しているが、（実施の形態9）で示した記憶手段を用いる場合でも、同様に実施することが可能である。

【0077】

【発明の効果】以上のように本発明によれば、OFDM伝送方式による送信装置及び受信装置において、簡易的な方法で信号帯域外スペクトルを小さくすることが可能となり、周波数の有効に利用することができるという有利な効果が得られる。

【図面の簡単な説明】

【図1】本発明の一実施の形態による送信装置の構成を示すブロック図

【図2】本発明の一実施の形態による電力変更器の入力信号の周波数スペクトルを示す概略図

【図3】本発明の一実施の形態による電力変更器の出力信号の周波数スペクトルを示す概略図

【図4】本発明の一実施の形態による受信装置の構成を示すブロック図

【図5】従来のイメージ除去用低域通過フィルタの周波数スペクトル特性を表す概略図

【図6】本発明の一実施の形態による帯域選択増幅器の周波数スペクトル特性を表す概略図

【図7】本発明の一実施の形態による送信装置の入力段の一部の構成を示すブロック図

【図8】本発明の一実施の形態による重要度考慮S/P変換器でのS/P変換による周波数スペクトルと信号重要度との関係を示す概略図

【図9】本発明の一実施の形態による通信機の構成を示すブロック図

【図10】本発明の一実施の形態による送信装置の構成を示すブロック図

【図11】本発明の一実施の形態による送信装置内の数値制御発振器の構成を示すブロック図

【図12】本発明の一実施の形態による送信装置内の数値制御発振器の構成を示すブロック図

【図13】本発明の一実施の形態による送信装置内の数値制御発振器周辺の一部の構成を示すブロック図

【図14】本発明の一実施の形態による送信装置の数値制御発振器の概略構成を示すブロック図

【図15】本発明の一実施の形態による数値制御発振器内のアドレス決定部の構成を示すブロック図

【図16】本発明の一実施の形態による送信装置の数値制御発振器の概略構成を示すブロック図

【図17】本発明の一実施の形態による送信装置の数値制御発振器の概略構成を示すブロック図

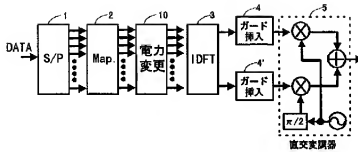
【図18】従来のOFDM方式による送信装置及び受信装置の構成を示すブロック図

【符号の説明】

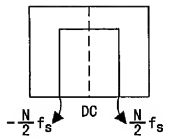
1　S/P（シリアル/パラレル）変換器
2　マッピング器
3　IDFT（逆離散フーリエ変換）器
4　ガード挿入器
5　直交変調器
6　帯域通過フィルタ
7　アップコンバータ
8　低域通過フィルタ
9　送信アンテナ
10　電力変更器
11　受信アンテナ
12　帯域通過フィルタ
13　直交復調器
14　低域通過フィルタ
15　A/D（アナログ/ディジタル）変換器
16　ガード除去器
17　DFT（離散フーリエ変換）器
18　デマッピング器
19　P/S（パラレル/シリアル）変換器
20　重要度調査器
21　重要度考慮S/P変換器
22　数値制御発振器（NCO）
23　加算器
24　シンボルタイミング発生器
25　一定位相出力器
26　アキュムレータ
27　遅延器

28　初期位相発生器
29　切り捨て器
30　ROM
31　振幅変更器
32　可変位相ステップ発生器
33　数値制御発振器（NCO）
34　乗算器
35　可変係数設定器
36　共有ROM
37　入力バス
38　記憶手段
39　出力バス
40　アドレス一致検出器
41　アドレスシフト器
100　帯域選択増幅器
101　通信機
102　受信装置
103　送信装置

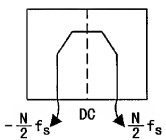
【図1】



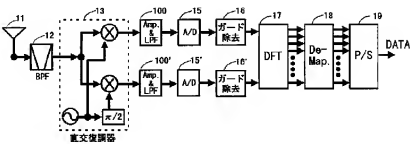
【図2】



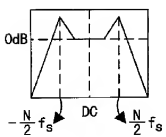
【図3】



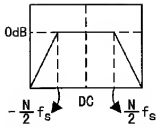
【図4】



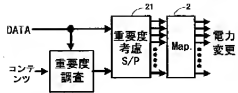
【図6】



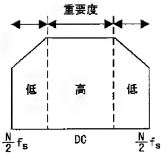
【図5】



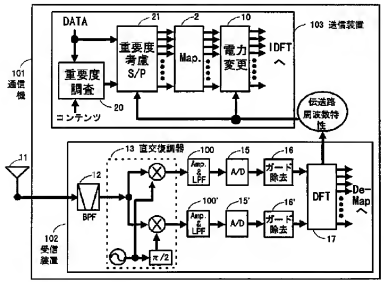
【図7】



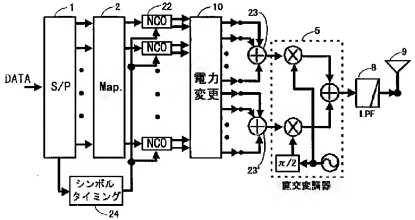
【図8】



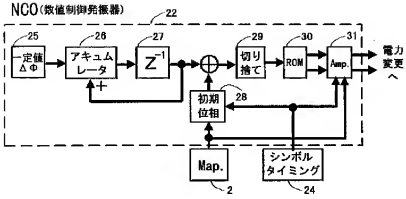
【図9】



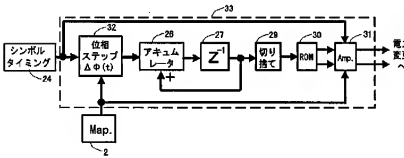
【図10】



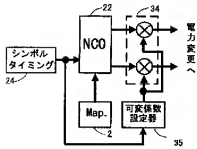
【図11】



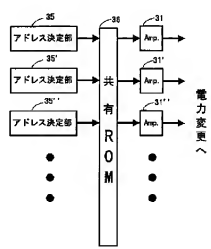
【図12】



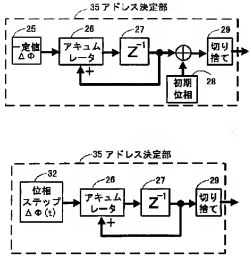
【図13】



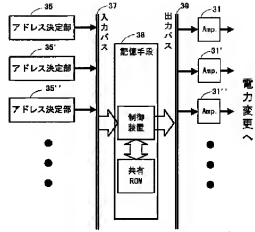
【図14】



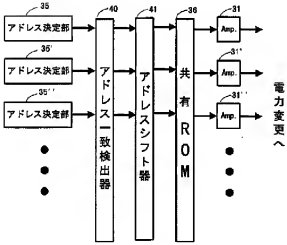
【図15】


35 アドレス決定部
25
一定値 Δφ
26
アキュムレータ
27
Z-1
29
切り捨て
28
初期位相
35 アドレス決定部
32
位相ステップ Δφ(t)
26
アキュムレータ
27
Z-1
29
切り捨て

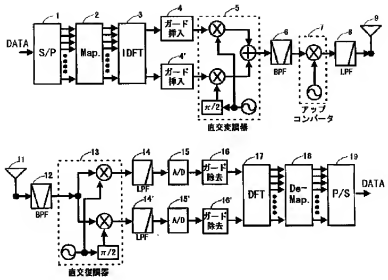
【図16】


35
アドレス決定部
35'
アドレス決定部
35''
アドレス決定部
37
入力バス
38
記憶手段
制御装置
共有ROM
39
出力バス
31
Amp.
31'
Amp.
31''
Amp.
電力変更へ

【図17】


35
アドレス決定部
35'
アドレス決定部
35''
アドレス決定部
40
アドレス一致検出器
41
アドレスシフト器
36
共有ROM
31
Amp.
31'
Amp.
31''
Amp.
電力変更へ

【図18】



フロントページの続き

(72)発明者　國枝　賢徳
神奈川県川崎市多摩区東三田３丁目10番１号　松下技研株式会社内

Ｆターム(参考)　5K022 DD01 DD13 DD19 DD23 DD33